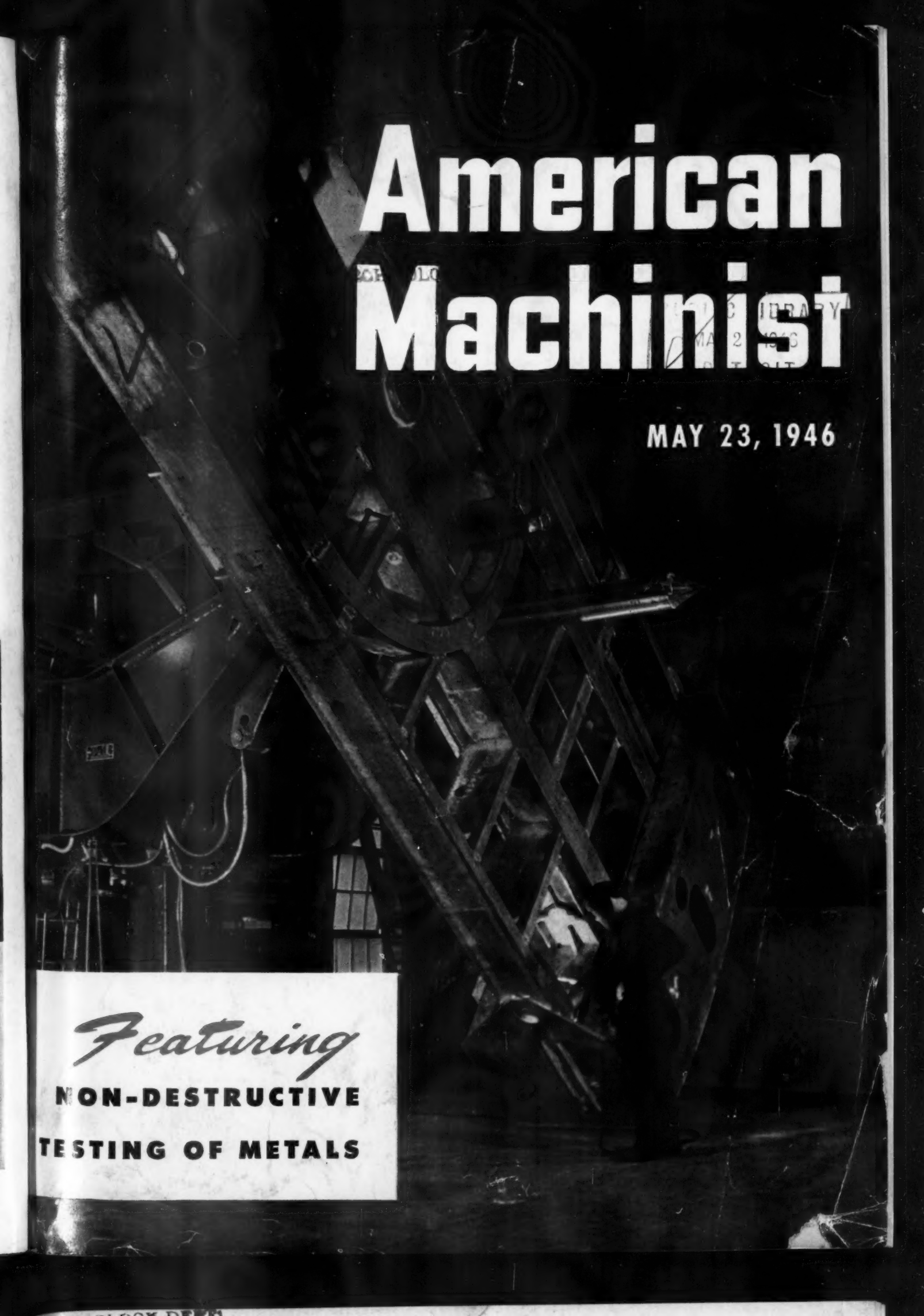

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With costs rising all along the line, you've got to get the most out of your machine tools if you're going to produce at a profit. That's where Heald engineering comes in—pointing the way to more economical production . . . to simplified set-ups and automatic control . . . with the very latest equipment for precision finishing, by grinding or borizing.

Here, for example, is how one manufacturer gained by bringing his problem to Heald. He had cylinders that required boring, turning, chamfering, and facing. It looked like a job for twelve lathes . . . until Heald engineers showed him how to get a better production rate with just two Bore-Matics. Result: he saved 40% in equipment cost, 83% in floor space, 90% in man-hours . . . a total saving of 60% in the cost of the finished product!

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HEALD

means more precision . . . less cost

INTERNAL AND SURFACE GRINDING MACHINES • BORE-MATIC PRECISION FINISHING MACHINES

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American Machinist

MAGAZINE OF METALWORKING PRODUCTION

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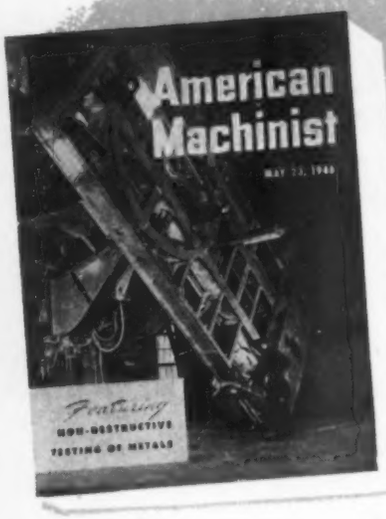

Chips and QUIPS

Some Position . . . The all-welded 32,000-lb. revolving frame for an electric excavator is handled with ease by the custom-built P & H weld positioner shown in our cover Kodachrome. Built by Harnischfeger Corporation, the positioner has variable-speed motion and table rotation, independent power elevation and a column-in-floor base.

Minihole . . . Hamilton Watch, Kollsman Instrument and American Bosch drill and tap tiny holes so frequently they consider the jobs routine. But many other companies face such work with fear and trembling. So we've asked these three companies to come clean on their tricks, and Associate Editor Wharen tells all to lead this issue.

Hurt-me-not . . . Rupert Le Grand has at last squeezed his voluminous data on non-destructive testing into a compact 24-page special report—our longest thus far. His original assignment was 16, but war-developed new methods and war-expanded older ones had so many vital angles he missed his budget by 50%.

Quickies . . . Continuing our program of keeping articles short and sweet, we tell in this issue of a stiffer boring bar—all tungsten-carbide, of methods for cold-molding plastics, and extract a very interesting discussion on causes of chatter.

With a Smile . . . This is a world with too many long faces, so it is a real privilege to introduce two men who see the lighter side. Mr. Whittemore's picture and biography are here, his reminiscences on pages 110 to 113. Mr. Fluharty, whose series "Our Shop" continues in this issue, has drawn his portrait, confessing he "nearly spoiled the likeness trying to make it look human."

"Flu" . . . Here is Fluharty's story:
I am Scotch-Irish, age 18 mentally, 48 total indicator reading. Born in Chasetown, Ohio, and moved to Kentucky against my better judgment at the age of one year. Stayed for college but left when they insisted I wear shoes. Did not steal my trade! Was apprentice toolmaker—tool engineer—mechanical research engineer—in 24 easy years, then I was demoted to factory manager, master mechnic, etc., and now own part of a small shop where we do not make much money, but have a lot of fun.

5′ 12″ high, weight 178 stripped and 178½ fully clothed to OPA restrictions, including shoes that still hurt!

As a toolmaker, I have loafed in about every state east of the Mississippi, and have been fired from the best shops.

Studied fine art 15 years; too simple; took up cartooning.

As a hobby, I like beautiful women.

1917 Volumes . . . Are you searching hopelessly for bound volumes of *American Machinist* for 1917? Stuart Swinney of Cincinnati has sent us his, which we'll be glad to pass along to someone.

Coming . . . Sapphire, man-made, is finding many uses. They're described in *American Machinist* for June 6. Another hard material, tungsten carbide, comes in for further attention as well . . . Ernest Wildhaber goes on with his meaty series on hypoid gears, this time talking about tooth contact . . . There's a special report on patents, another on German metalworking equipment . . . All-in-all, it will be something to study.

YANKEE APPRENTICE . . . Herbert L. Whittemore, author of "Yankee Metalworking—1900" in this issue, is a holder (1927) of the Moorehead Medal, the Longstreth Medal (1937) and inventor of the strain gage which bears his name. A member of the AAE, ASME, ASTM, AWS, and the Washington Academy of Sciences, he has authored many government reports on strength and stress distribution, tests in and design of low-cost housing. He has been chief of the Engrg. Mechanics Section, National Bureau of Standards, Washington, since 1917, wrote first for *American Machinist* in 1905.

Born in Milwaukee in 1876, Mr. Whittemore spent five years in shops there, Chicago and Hartford as an apprentice and machinist. Later he was asst. supt. of Sullivan Machinery (1902-04), engineer at A. P. Hanson Co., Berlin, Germany, production engineer for British Westinghouse, instructor in engrg. mechanics and strength of materials at the Univ. of Ill., test engineer at Watertown Arsenal, instructor at Columbia, and professor of mechanics at the University of Okla.

To show the breadth of his interests, he's even made racing model yachts and a planked canoe. This likeness was taken in 1923, and is the most recent released for publication by Mrs. Whittemore.

DESIGNED FOR FASTER PRODUCTION

The New Gleason No. 16 Quenching Press offers you

- **QUICK SET-UPS**
- **SIMPLIFIED CHANGING OF WORK AND DIES**

and quenching of heated parts WITHOUT DISTORTION

Designed for faster production . . . no mere phrase, but actual fact . . . the Gleason No. 16 Quenching Press incorporates positive control of the work with an entirely automatic metallurgically correct oil flow . . . lower die mechanism returns to loading position at end of each cycle to facilitate changing of work and dies . . . built-in pumping system and oil reservoir require only 35 gallons of external oil supply per minute yet can deliver as high as 225 gallons per minute.

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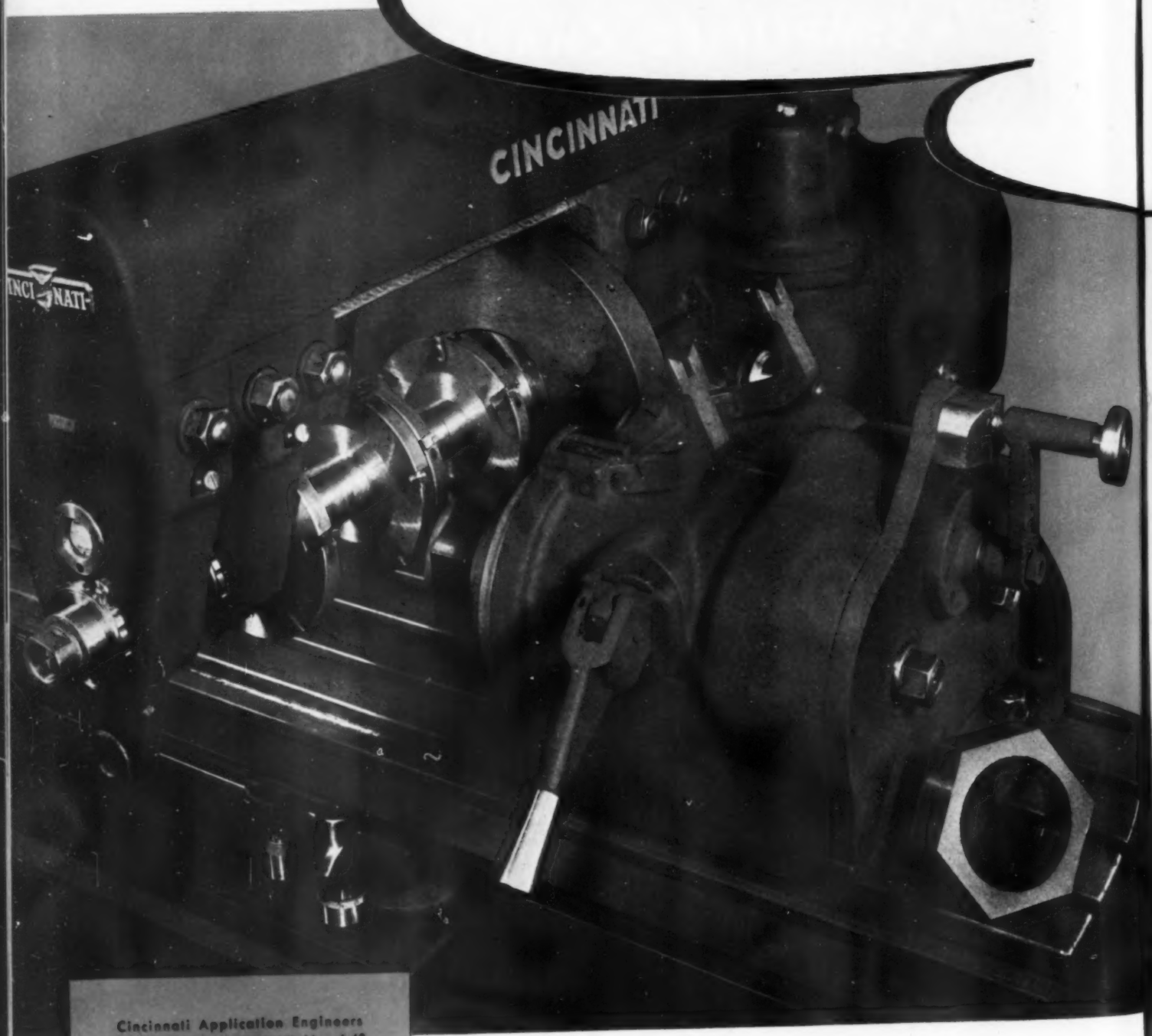
CINCINNATI

IT'S BUILT FOR



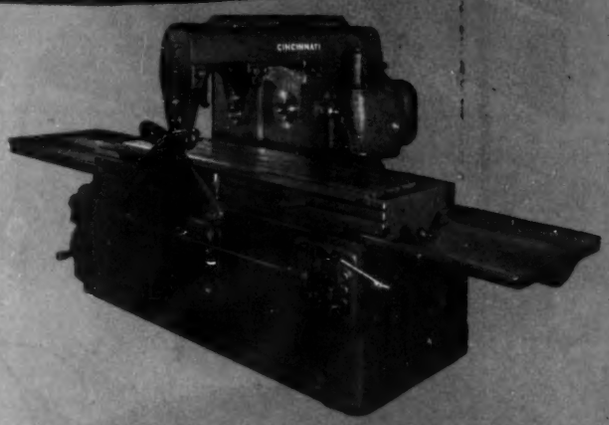
Cincinnati Application Engineers equipped this CINCINNATI No. 4-48 Plain Hydromatic with a two-spindle fixture and high speed carbide cutters to mill seven sizes of stainless steel hex nuts. The largest size part milled with this setup is shown on the right-hand end of the table.

THE CINCINNATI

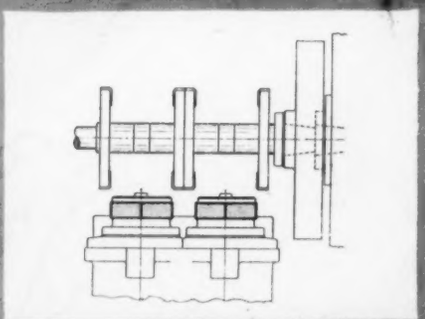
MILLING MACHINES

HIGH SPEED CARBIDE MILLING

• Milling operations on stainless steel parts—like the hex nut setup illustrated at the left—require special techniques. Cincinnati's metal cutting researchers know what this special consideration is, so they prescribed negative rake high speed carbide milling on a new CINCINNATI Hydromatic for the operation illustrated. ¶ This new machine has what it takes for high speed carbide milling operations on all types of steel and cast iron. Overarm has a built-in vibration damper; table ways are square gibbed. Principal castings are exceptionally heavy and rigid. For example, the headstock casting for medium size machines weighs over 2500 pounds, while the spindle carrier casting weighs 1100 pounds. You have your choice of seven ranges of spindle speeds for all types of milling operations. Foolproof lubrication, conveniently located elements of control, structural massiveness and plenty of power make for a machine that is extremely accurate, operates smoothly under all conditions, at a minimum of operator effort. It is well able to handle operations requiring sintered carbide in addition to high speed steel cutters. ¶ We'll be glad to tell you more about the features and milling capabilities of the new CINCINNATI Hydromatic.



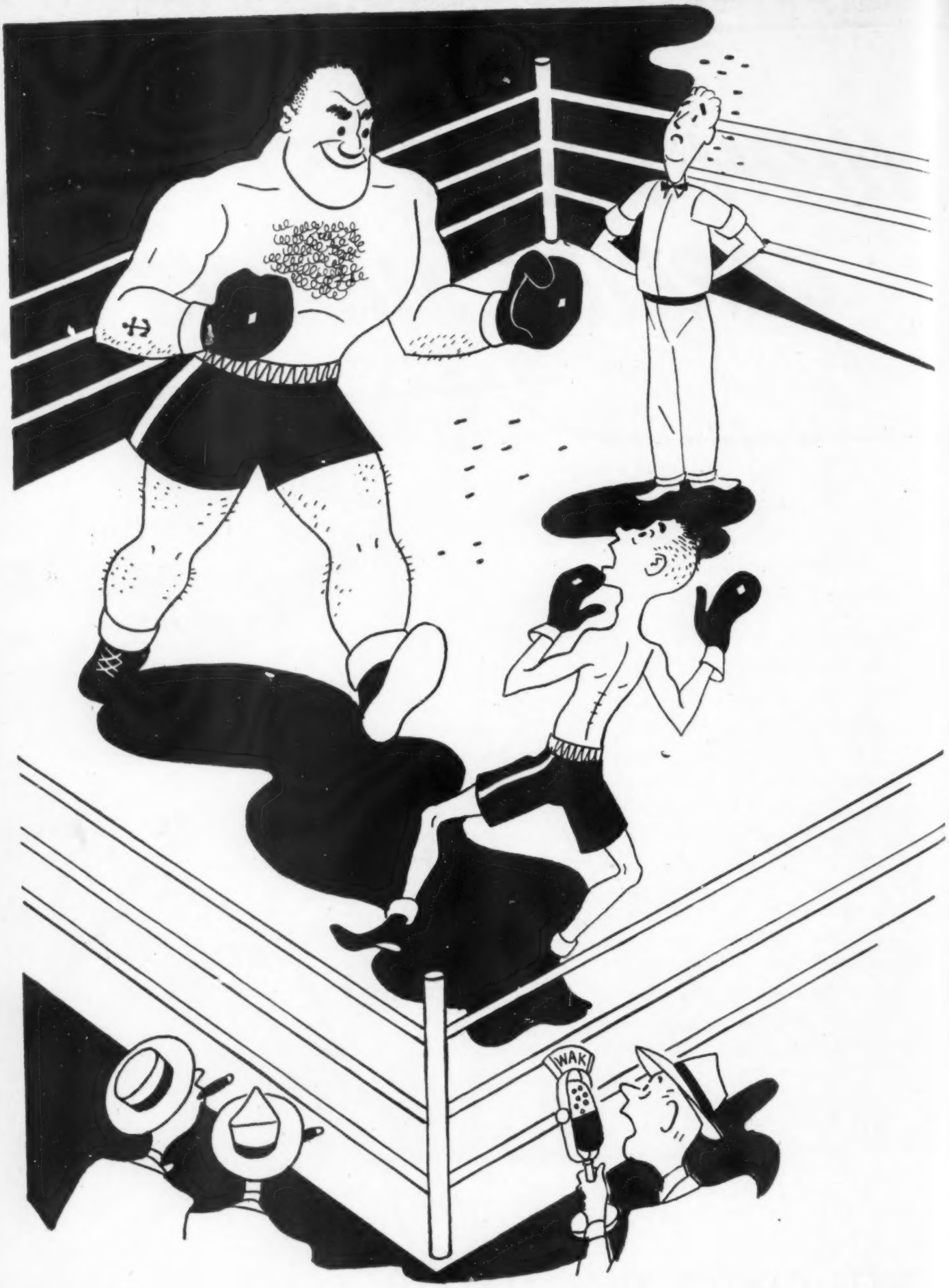
CINCINNATI No. 5-60 Plain Hydromatic Milling Machine. Also built in Duplex style; 12 sizes of each. Complete engineering specifications may be obtained by writing for Catalog M-1372-1. A brief description is given in Sweet's Catalog File.



***Name of part:* Hex nut. *Material:* Stainless steel. *Operation:* Mill 6 sides. *Spindle speed:* 190 r.p.m. *Cutting speed:* 445 feet per minute. *Production:* 48 hex nuts per hour.**

MILLING MACHINE CO. CINCINNATI 9, OHIO, U.S.A.

BROACHING MACHINES • CUTTER SHARPENING MACHINES


WAK

you wouldn't

Nor should you put carbide cutting tools on a lathe lacking the fundamentals for their most efficient use. These cutting tools have increased horsepower requirements 300 per cent and more. They have increased cutting speeds 200 to 500 per cent.

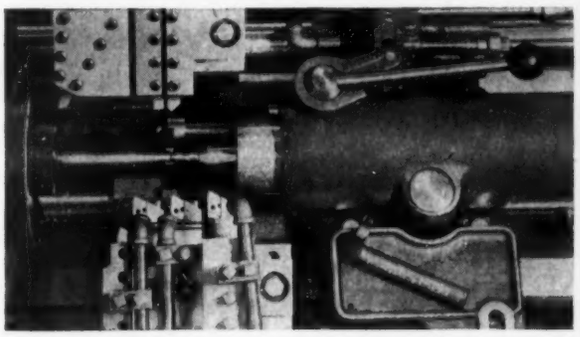
Your profits may well depend upon the efficiency of your turning operations. For instance, in your plant, turning probably accounts for 25 per cent or more of machining time. This could be substantially reduced by the most efficient use of carbide cutting tools, and an important saving in manufacturing cost effected.

It will pay you to check now on the production efficiency of all metal turning equipment in your plant — and to replace it, if need be, with high production war surplus machines or new machines. Jones & Lamson Fay Automatic Lathes and Universal Turret Lathes are designed specifically for the most efficient use of carbide cutting tools.

We are anxious to assist all owners of Jones & Lamson equipment bought from government surplus, to obtain the best possible results from their purchases. Telephone or write to us for complete particulars.

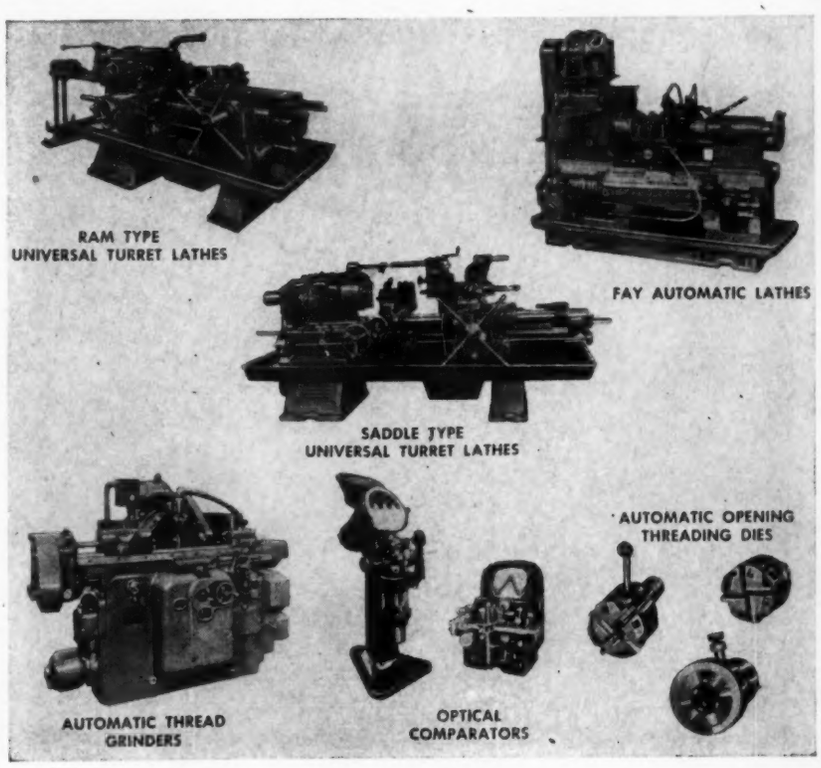
What Horsepower Are YOU Using?

15 horsepower is required to turn and face this small steering rod at the high surface speeds required by the carbide cutting tools. Fay Automatic Lathes are designed specifically for the most efficient use of carbide cutting tools.



Engineered to "Carry the Load" for Most Productive Operation With Carbide Cutting Tools

Fay Automatic Lathes

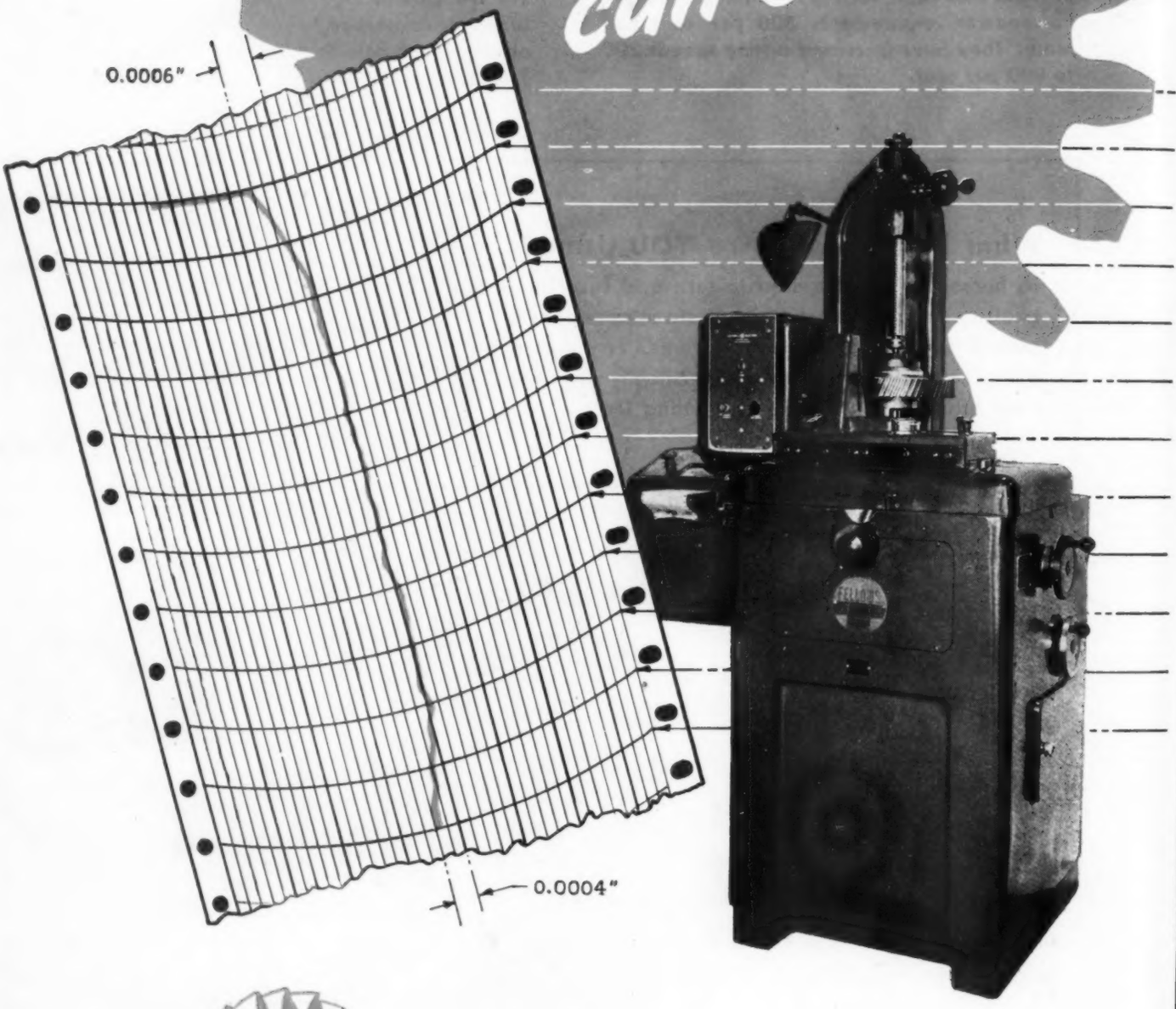


JONES & LAMSON
MACHINE COMPANY
SPRINGFIELD, VERMONT, U. S. A.

Manufacturer of: Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers • Ground Thread Flat Rolling Dies.

INSPECTION that Analyzes

where all can SEE



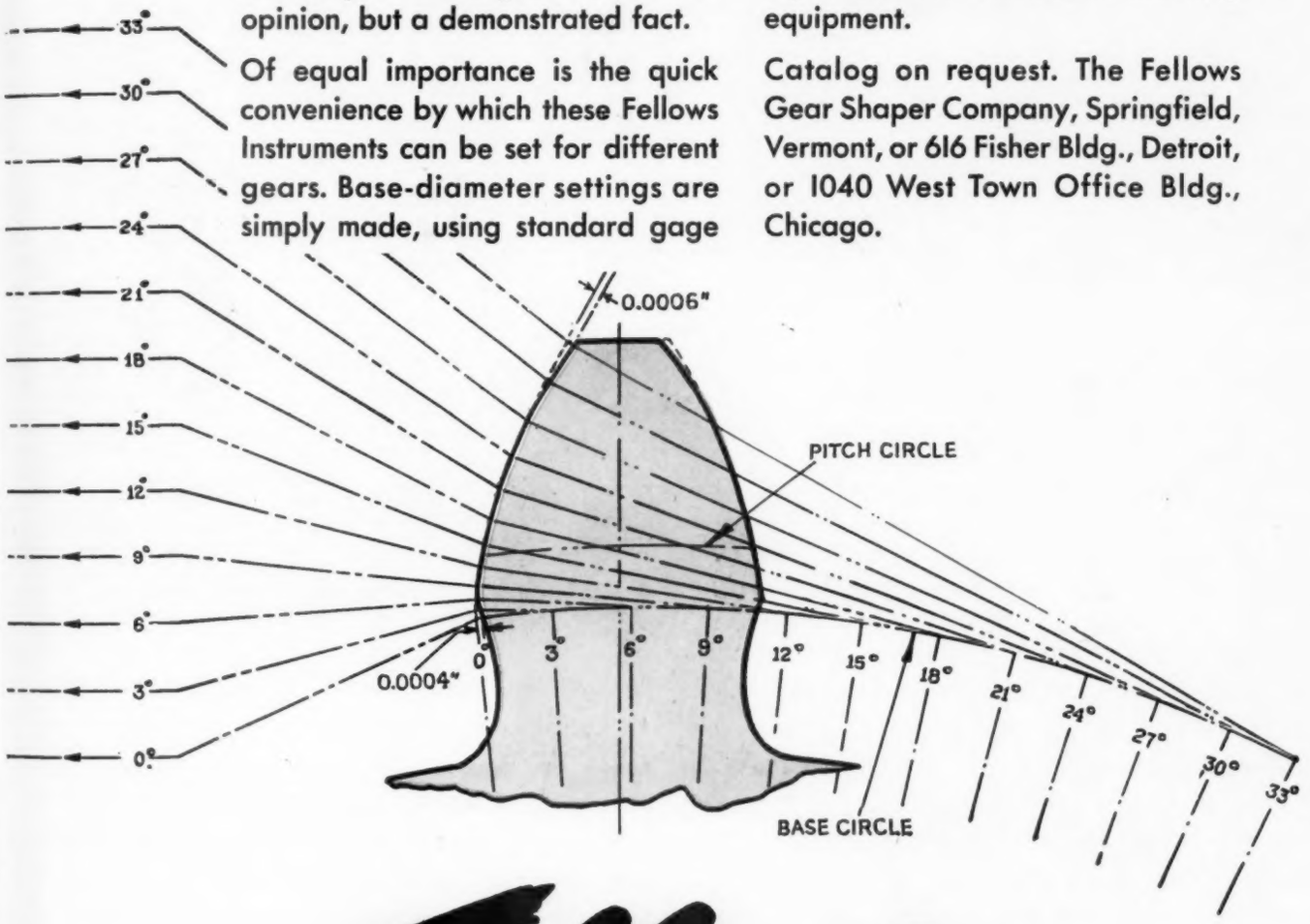
THE FELLOWS METHOD... MACHINES AND TOOLS FOR

Tooth Profiles

Fellows Involute Measuring Instruments are provided with automatic electrical recorders. These produce charts of tooth profiles which can be studied and analyzed. With a chart at hand, cutter or machine accuracy is no longer a matter of opinion, but a demonstrated fact.

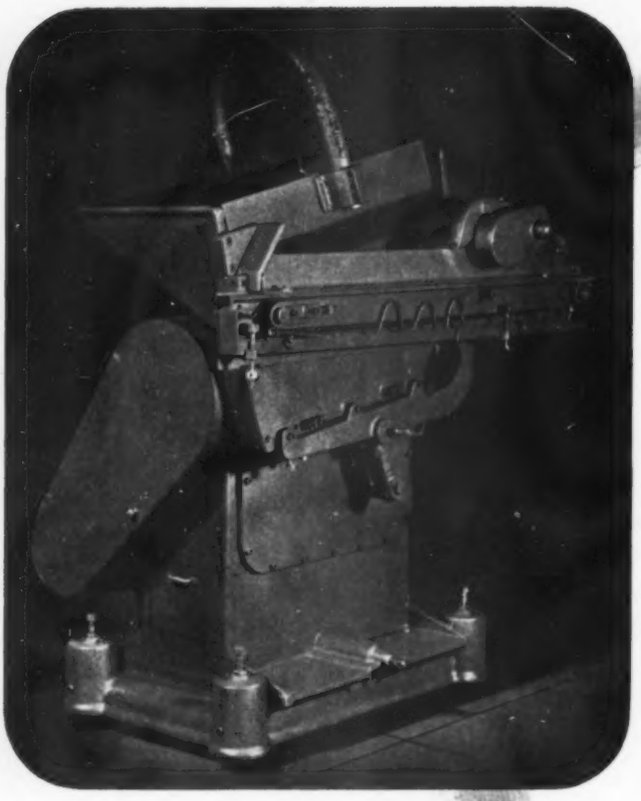
Of equal importance is the quick convenience by which these Fellows Instruments can be set for different gears. Base-diameter settings are simply made, using standard gage blocks to position the involute pointer at the correct base circle radius. Nothing could be easier. Other adjustments are simply and quickly made. For convenience in setting as well as accuracy, this instrument represents the ultimate in checking equipment.

Catalog on request. The Fellows Gear Shaper Company, Springfield, Vermont, or 616 Fisher Bldg., Detroit, or 1040 West Town Office Bldg., Chicago.



Fellows

ALL OPERATIONS FROM BLANK TO FINISHED GEAR



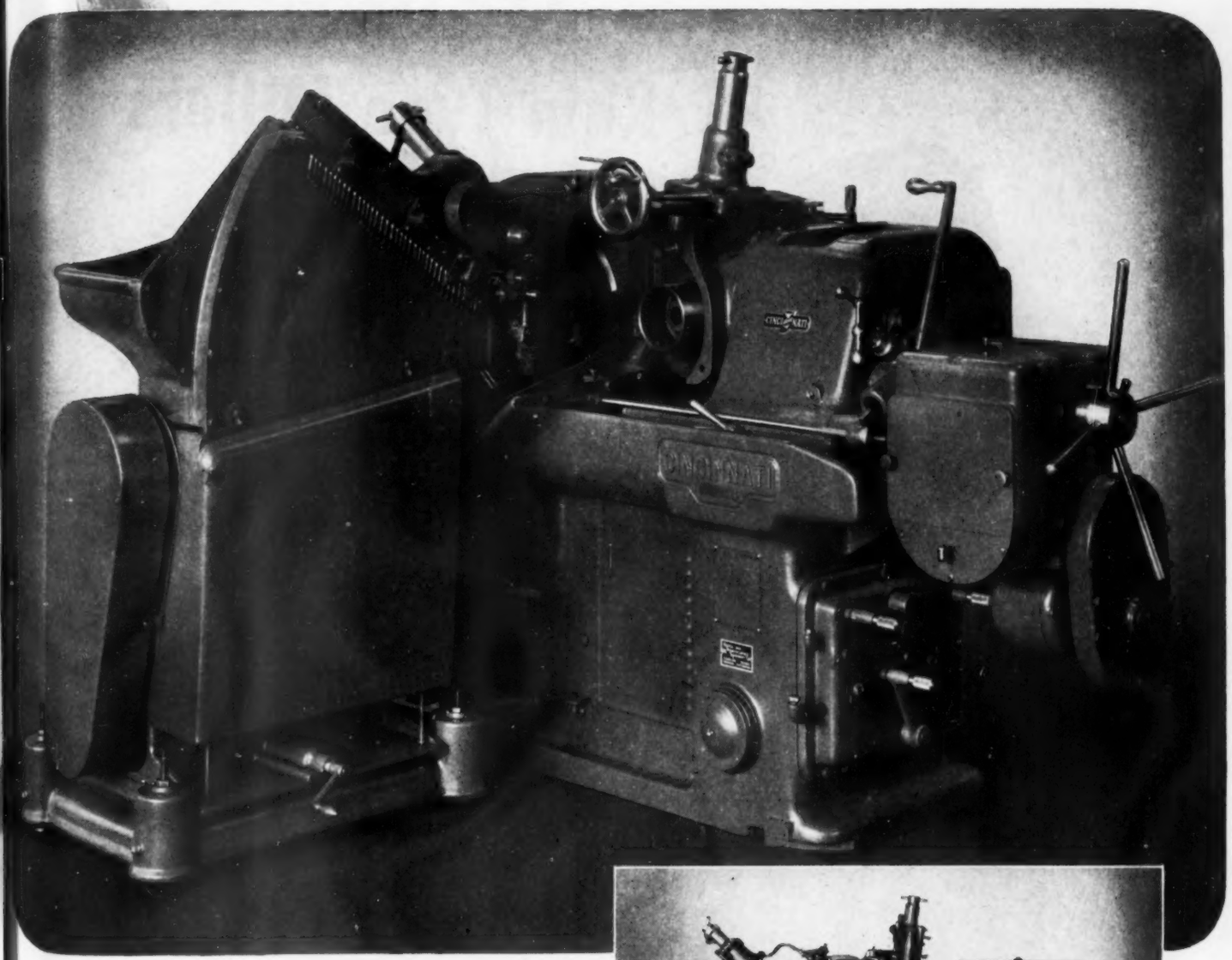
CINCINNATI Type E FEEDMATIC Hopper for Thrufeed Grinding on CINCINNATI Centerless Grinding Machines. Both types are powered by ½ h.p. motor.

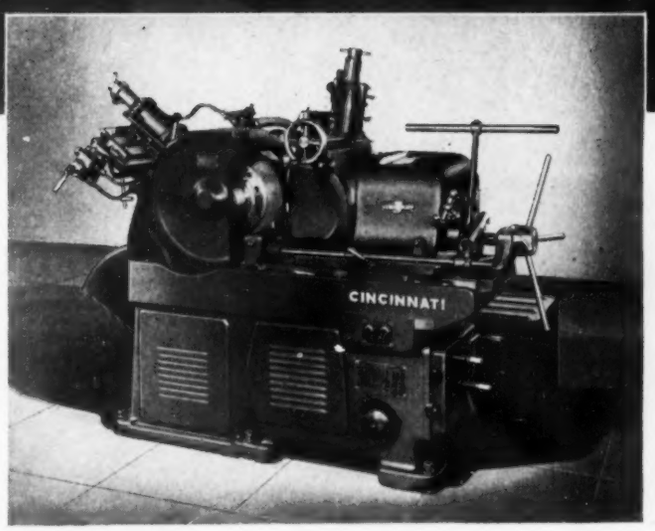
KEEP THE CINCINNATI FEEDMATIC HOPPERS FULL *and grinding is continuous!*

● CINCINNATI FEEDMATIC Hoppers eliminate all manual feeding operations and thus greatly increase production of Infeed and Thrufeed grinding operations on CINCINNATI Centerless Grinding Machines. ¶ Type B FEEDMATIC Hopper, for Infeed grinding, handles headed work up to 8" in length under the head, such as studs, chain pins, valve tappets. Type E FEEDMATIC Hopper handles all types of Thrufeed work including parts requiring a very high finish, such as piston pins, small shafts, bushings and similar work from ¼" to 1½" diameter, and twice the diameter up to 18" in length. ¶ One man can operate more than one machine because the operator simply keeps the hopper full. Mounted on casters, they can be easily moved from one machine to another. Grinding is continuous. Work will not jam in the hopper, thus assuring dependable operation. And occupational hazard is reduced, too. ¶ For long runs of Infeed or Thrufeed grinding, you'll find it profitable to use CINCINNATI FEEDMATIC Hoppers. Complete details will be sent on request.

CINCINNATI

CENTER TYPE GRINDING MACHINES





CINCINNATI No. 2 Centerless Grinder with Type B FEEDMATIC Hopper set up for automatically in-feed grinding connecting rod bolts. Automatic Infeed Attachment controls the timing of the hopper. Production—936 bolts per hour.

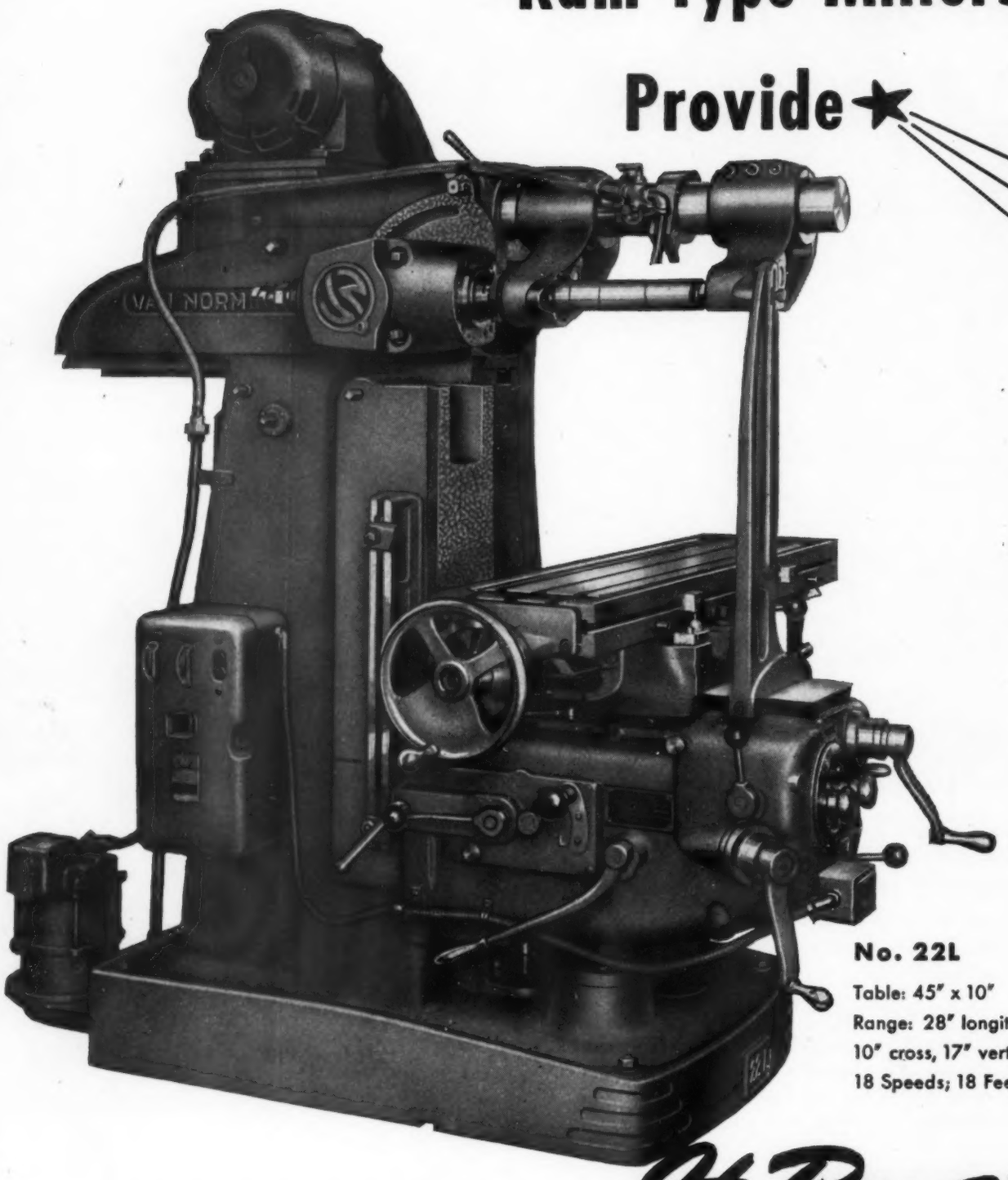
CINCINNATI No. 2 Centerless Grinding Machine. Complete engineering specifications may be obtained by writing for Catalog G-456-4. For a brief description look in Sweet's Catalog for Mechanical Industries.

GRINDERS INCORPORATED

CINCINNATI 9, OHIO, U. S. A.

CENTERLESS GRINDING MACHINES • CENTERLESS LAPPING MACHINES

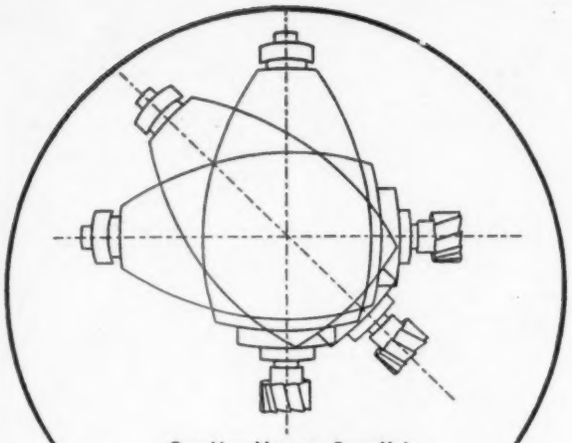
Van Norman Ram Type Millers Provide ★



No. 22L

Table: 45" x 10"
Range: 28" longitudinal,
10" cross, 17" vertical
18 Speeds; 18 Feeds

It Pays to



One Van Norman Ram Universal Miller gives You the work range of several types of millers.

★ ***Horizontal, Angular, Vertical Milling . . . All with ONE Miller***

★ ***Ease of Operation with Front and Rear Directional Controls***

★ ***Greater Work Range with Movable Ram***

Only Van Norman Ram Type Millers give you the adjustable cutterhead . . . an exclusive feature on Van Norman Ram Type Millers that permits you to perform every type of milling from horizontal to vertical . . . provide the work range of several single-purpose machines with one miller.

This advantage is especially important to those plants where daily milling requirements continually change. For example, one job calls for horizontal milling, the next vertical, etc. . . . with Van Norman millers the operators simply swivel the adjustable cutterhead to the required position and go ahead with the work. This advantage multiplies when a number of ram type millers are available.

In addition, the versatility of these millers enables operators to *increase production by as much as* 50% because idle machine and operator time is minimized. Work reset-ups on most jobs are practically eliminated.

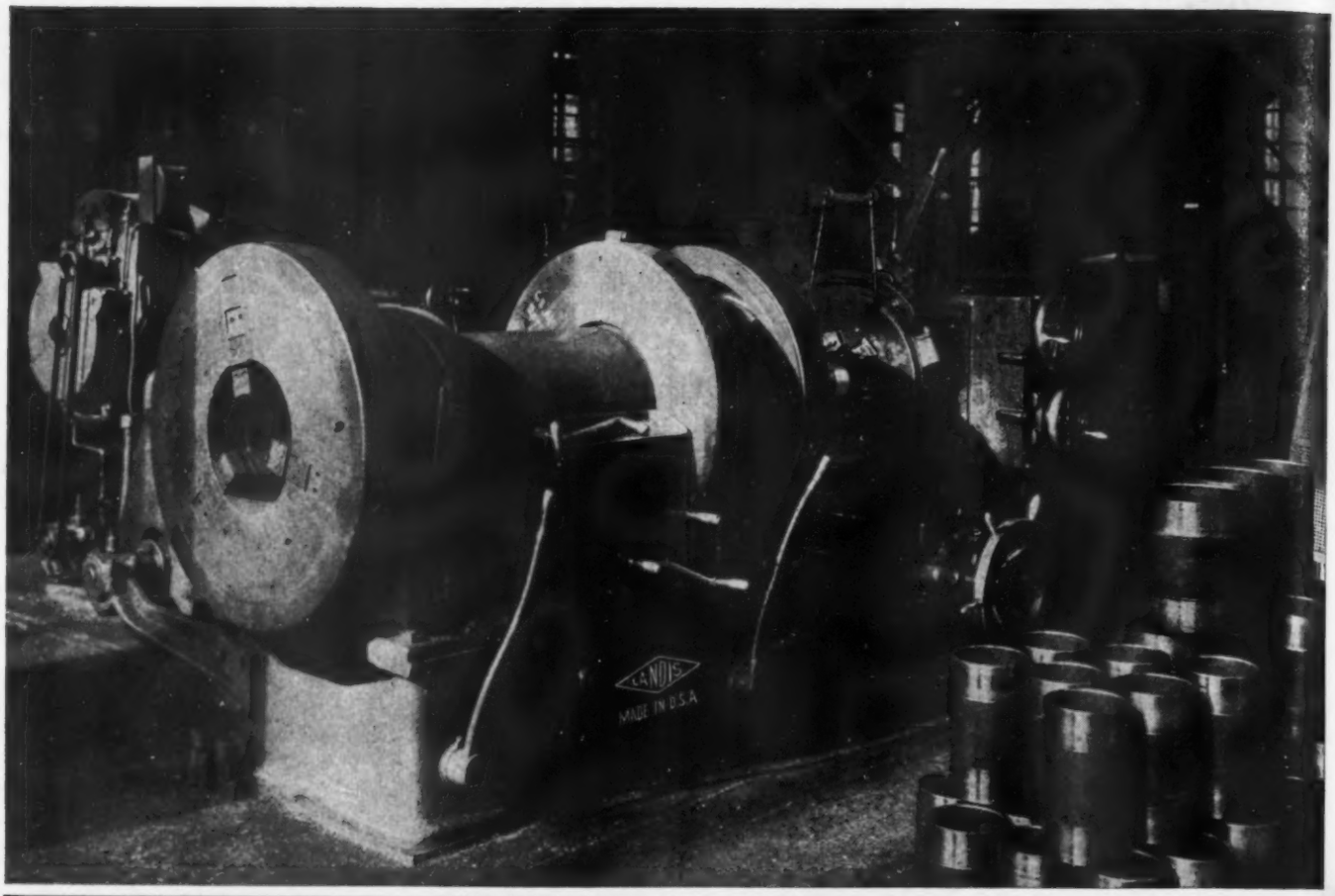
Other Van Norman features that speed production, cut costs, include—finger-tip directional front and rear controls of all power feeds, movable ram, exclusive Van Norman rotary feed selector and large easy-to-read dials, plain or swiveling tables.

Minimize costly delays and get maximum milling production . . . use Van Norman Ram Type Millers. Write for complete information, today.

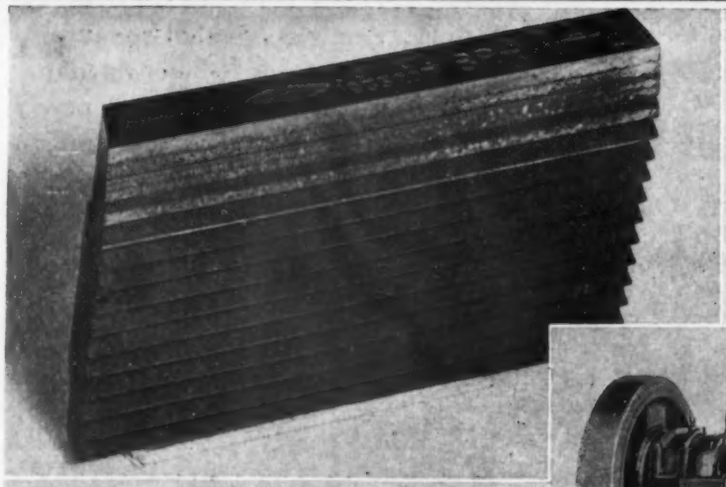
VAN NORMAN COMPANY

SPRINGFIELD 7, MASSACHUSETTS

Van Normanize"

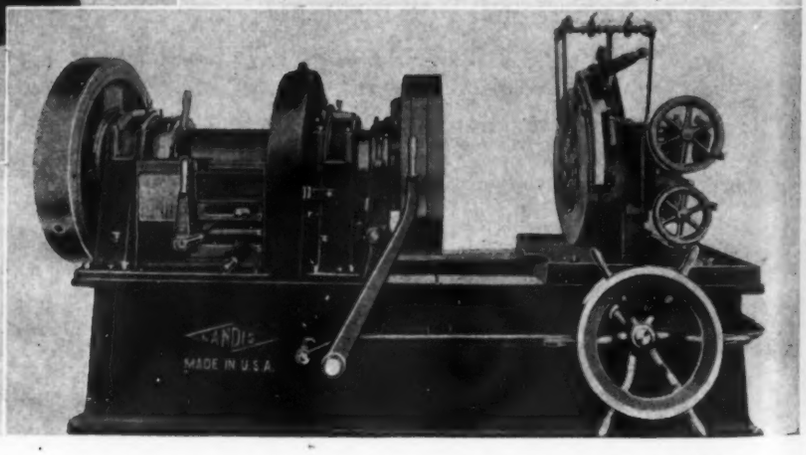


LANDIS MACHINE COMPANY



The Landis Stationary Die Heads applied to our Pipe Threading and Cutting Off Machines minimize spoilage—insure high degree concentricity due to floating action of die head in T-slot of cross rail.

Landis Tangential Pipe Chasers employed in Stationary Head—one set chasers required to cover range of die head—eliminates the changing of chasers for each diameter of threads produced—assuring accurately formed threads and low threading cost.



Accurate-Time Saving-Flexible

LANDIS PIPE THREADING AND CUTTING OFF MACHINES

Saves time—cuts cost—insures accuracy—in the production of pipe threads.
For heavy duty, continuous service—built in nine different sizes ranging from 2" to 20" inclusive.

Designed for flexibility in threading all diameters of pipe within their range.

Employs eight speed selective type gear box with cut steel gears—operating in continuous bath of oil—having reversing control.

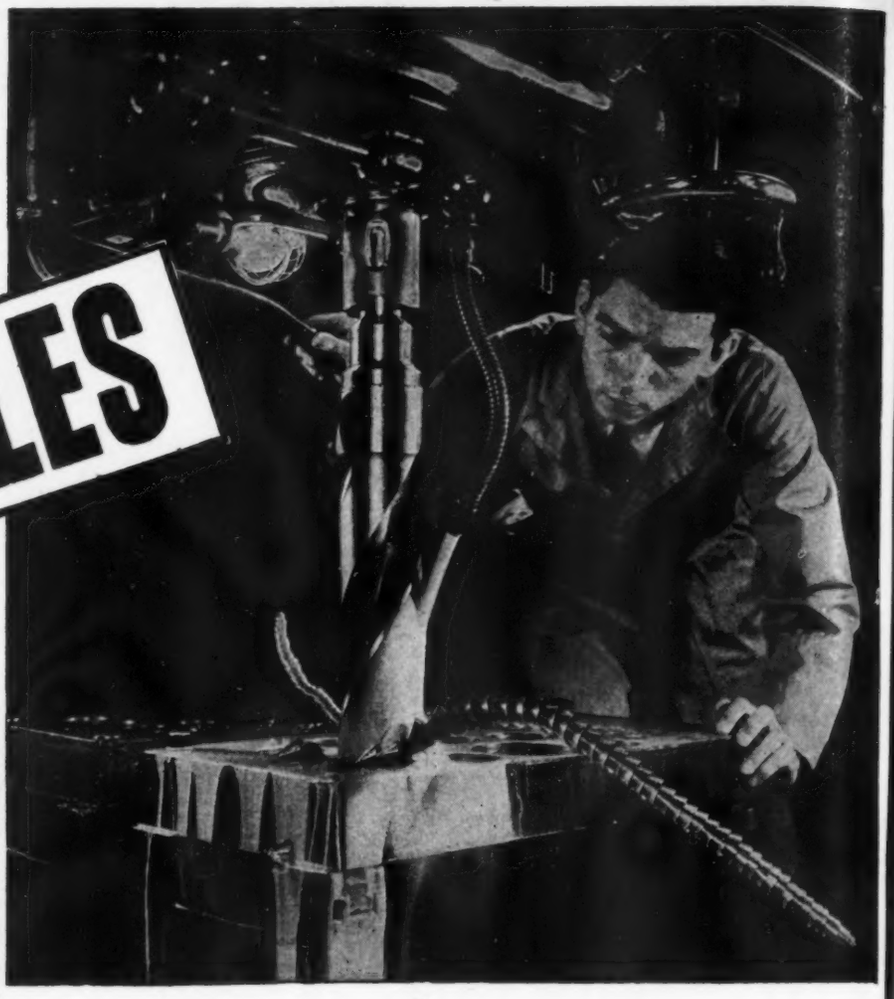
Front and rear chucks fitted with renewable rocket type grip inserts, replaceable at minimum cost. Gripping chucks with universal adjustment on 2" to 12" machines.

Here's the Pipe Threading and Cutting Off Machine you will find a profitable investment for production, jobbing, and maintenance pipe threading operations.

Write for complete information

WAYNESBORO · PENNA · U·S·A·

BIG HOLES



LITTLE HOLES

It makes no difference — there's an "AMERICAN" for every job.

"AMERICAN" Hole Wizard Radials are meeting the challenge of intensive production without a whimper. Day in and day out in the production shops throughout the country they are drilling, boring and tapping at top speed and at the same time maintaining amazing standards of accuracy.

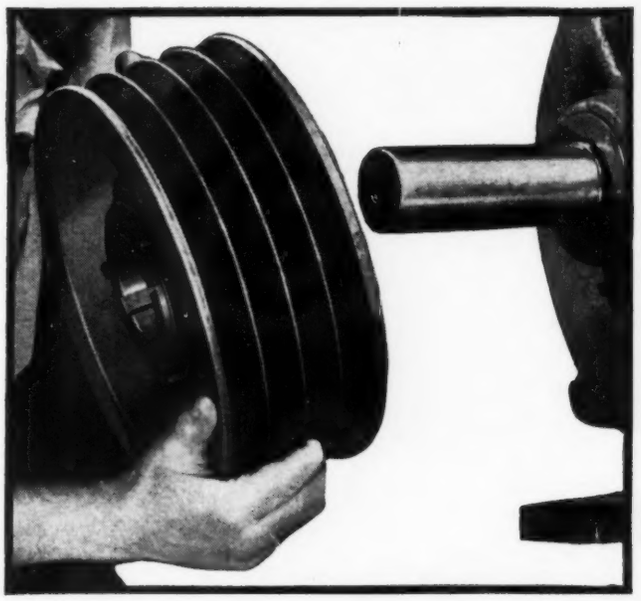
Manufacturing shops that have established enviable records for low cost production are using "AMERICAN" Radials.

THE AMERICAN TOOL WORKS CO.

Cincinnati, Ohio, U. S. A.

Lathes and Radial Drills

"MAGIC-GRIP" SHEAVE

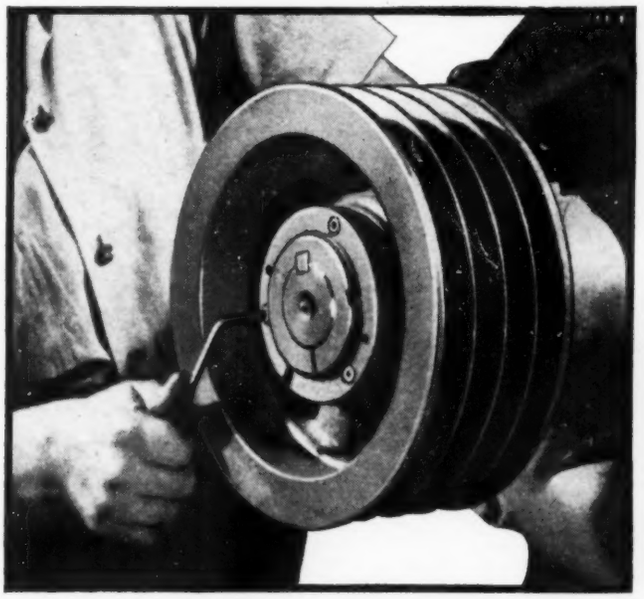


GOES ON EASY

There's plenty of clearance in the bushing of the patented "Magic-Grip" sheave. It slips easily on even oversize shafts . . . never requires filing, reaming or hammering. Think of the time and money *that* can save!

Sheave and bushing come completely assembled . . . one precision-made unit ready to mount. Slide it on the shaft to exact alignment. Then — tighten three cap screws with the handy wrench furnished. That's all! Any one can do the job—quickly, easily, accurately.

—GRIPS TIGHT



The sheave is locked on the shaft with the powerful grip of a vise. No slip, no backlash or wobble. Yet it can be removed as easily as it goes on.

"Magic-Grip" sheaves save time and money the first time they are installed . . . are indispensable for applications requiring frequent sheave changes. Yet they cost no more than standard sheaves of comparable heavy-duty construction.

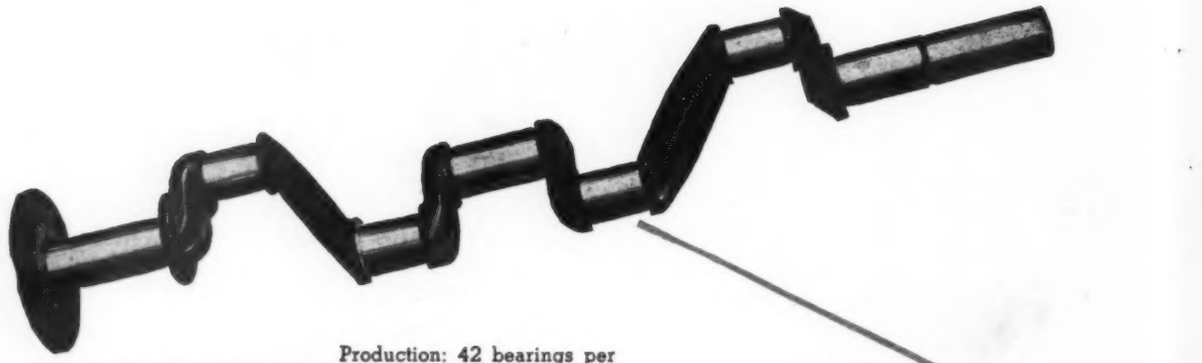
YOUR V-BELT DRIVE HEADQUARTERS

Call your nearest Allis-Chalmers office or dealer for TEXROPE "Magic-Grip" sheaves, Texsteel, Texdrive and Vari-Pitch sheaves, Speed Changers and famous TEXROPE Super-7 V-Belts. Full range of types and sizes. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 2035

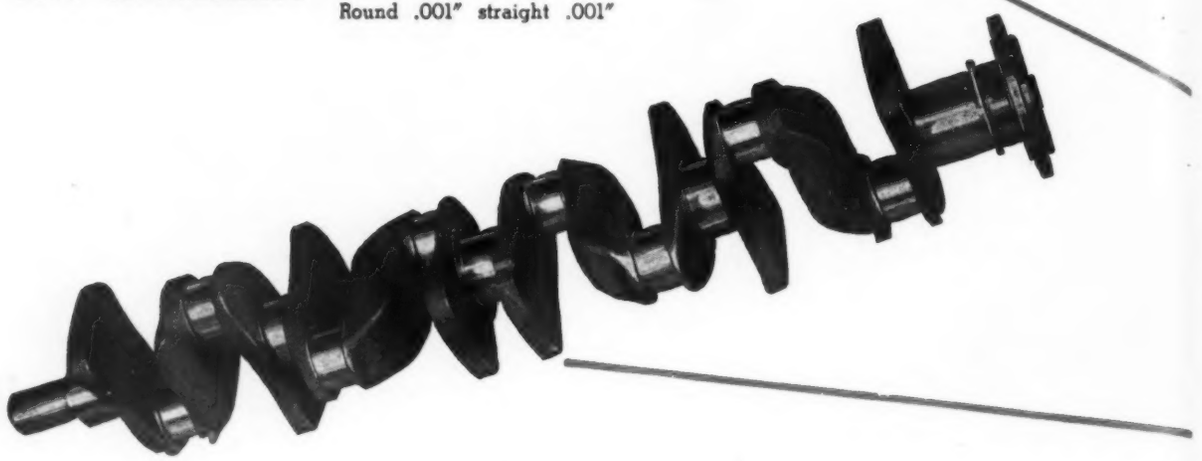
ALLIS CHALMERS TEXROPE V-BELT DRIVES

HEAR THE BOSTON "POPS": *Every Saturday Evening, American Broadcasting Co.*



1910 CRANKSHAFT

Production: 42 bearings per 8 hr. day. Tolerance for size: Round .001" straight .001"



TODAY'S CRANKSHAFT

Production: 320 bearings per 8 hr. day. Tolerance for size: Round. 0005" Straight. 0003"

The 100,000 mile automobile engine has become possible because of low cost mass production to progressively closer tolerances.

The increased production and closer tolerances of today's LANDIS TOOL grinding machines — typified by the crankshaft job shown above—are due to design developments pioneered by Landis Tool engineers.

The increase of almost 800% in bearing output comes from a combination of high production features first introduced on LANDIS TOOL grinding machines.

These include a single loading setup for grinding all pins: hydraulic controls for feed, traverse and work clamping; hydraulic rapid infeed; multi-function control lever. Tolerances were cut in half and accuracy doubled again as a result of LANDIS TOOL features that made possible high precision and fine finish. These include The Microsphere Wheel Spindle bearings for closer bearing clearance; dynamically balanced rotating parts to eliminate vibration; multiple V belt drive for smooth driving power; massive wheel base and machine bed for greater rigidity; casts parts annealed for stress removal.

If you have a grinding problem that involves cost reduction or precision finish, investigate the features of LANDIS TOOL—call on our engineers for help in solving your grinding problem. No. 44

CENTERLESS GRINDERS TOO, BY **LANDIS TOOL** ...OF OUTSTANDING NEW DESIGN. WRITE FOR CATALOG T44

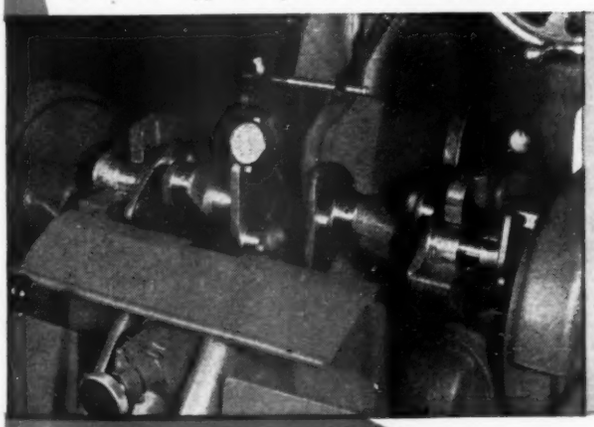
LANDIS TOOL
Precision Grinders

How Design Features of Landis Tool Grinders

Reduce Costs and give *Closer Tolerances*

Automotive Crankshaft grinding experience is typical

16″ x 42″ Type D Hydraulic Crank Grinder



Crank in Grinding Position with Visual Sizing gauge and crank carrying fixtures

HIGH PRODUCTION FEATURES

Hydraulic Rapid Infeed
Multi-function Control Lever
Hydraulic feed, traverse, workclamp.
Single setup for grinding all pins

PRECISION FINISH FEATURES

Microsphere Wheel Spindle Bearings
Dynamically Balanced Rotating Parts
Massive Wheelbase
Multiple V Belt Drive

LANDIS TOOL CO., WAYNESBORO, PA.

Medart SPFC Straightening Machine straightens angles, flats, squares and hexagons.

Fortified against friction and wear; fortified against radial, thrust and combined loads; fortified against misalignment of moving parts. Results: unhampered speed; unwavering precision; unhindered operation; unwearied endurance; unrestricted machine life.

The No. 1 size Medart SPFC Straightening Machine pictured above is Timken Bearing Equipped throughout — including the 4-speed gear box — a total of 48 Timken Tapered Roller Bearings being used.

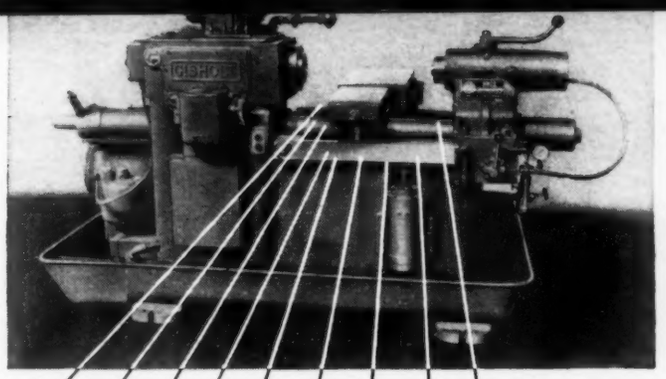
The Medart Company has been a user — and booster — of Timken Bearings for many years and emphasizes their advantages in various kinds of equipment, from pillow blocks to huge, heavy duty machines for steel mill service.

Every genuine Timken Bearing has the trade-mark "TIMKEN" stamped on it. Look for it on every bearing you use. The Timken Roller Bearing Company, Canton 6, Ohio.

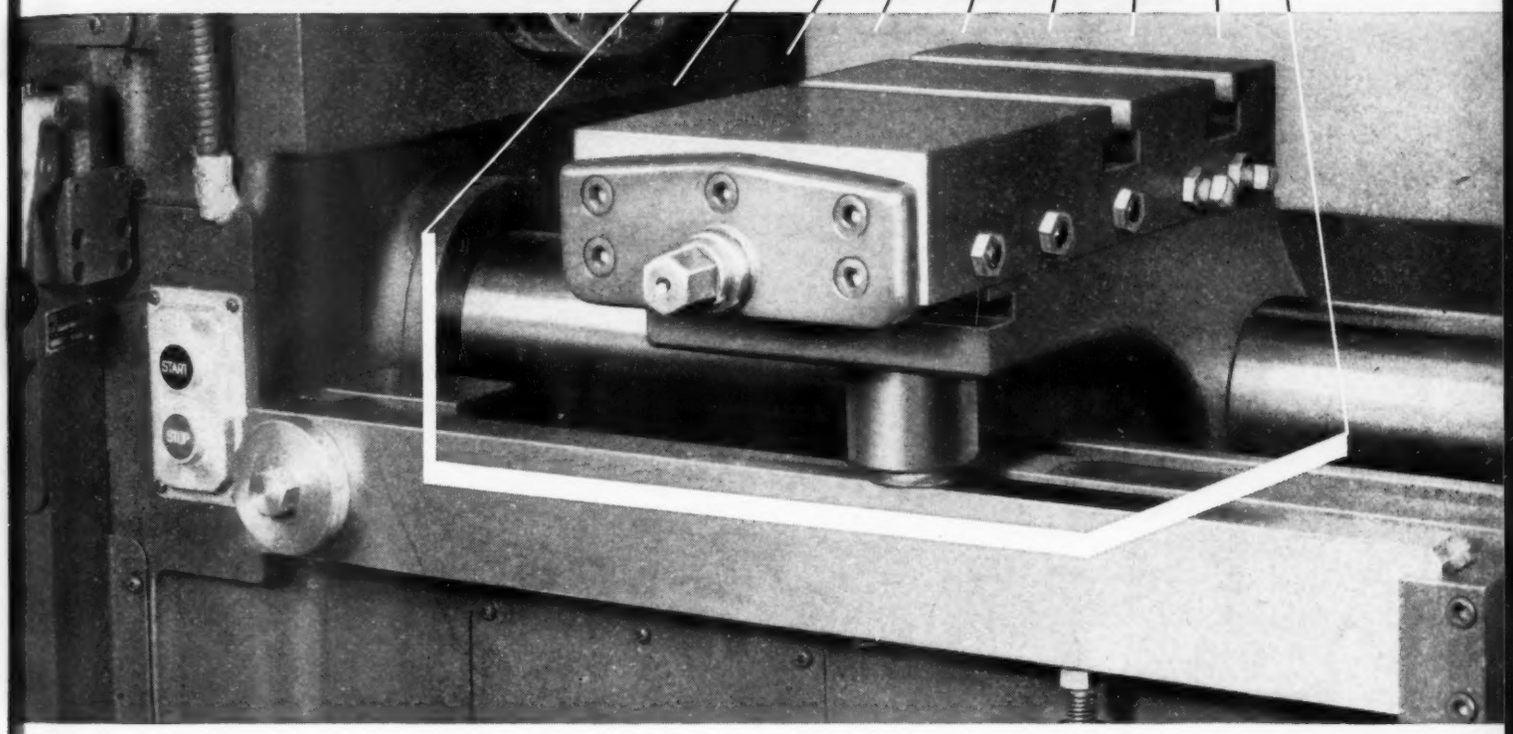
TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Why this front carriage is more versatile

Here's one of the many reasons why this machine can perform a number of different machining cycles and handle a remarkably wide range of work for an automatic lathe.



THE GISHOLT HYDRAULIC AUTOMATIC LATHE



The front carriage is clamped to, and receives its longitudinal motion from, a large diameter hardened steel bar along which the carriage may be clamped at any position.

The outer support for the carriage is a hardened steel beam of rectangular section, pivoted at one end and with an up-and-down motion for the other end provided by the piston-cylinder unit on the front of the machine. Raising or lowering this beam imparts a transverse movement to the carriage.

Many combinations of transverse and longitudinal motions can be made at both feed and traverse rates to meet practically every requirement. An angular in-feed attachment may be added for advancing multiple tools into the work at a controlled angle.

With a rear slide which can be placed on the bed table to feed in or out, straight or angularly, you have the combination that means faster, lower cost production on a wide variety of parts. Write for literature.

GISHOLT MACHINE COMPANY

1201 E. Washington Avenue • Madison 3, Wisconsin

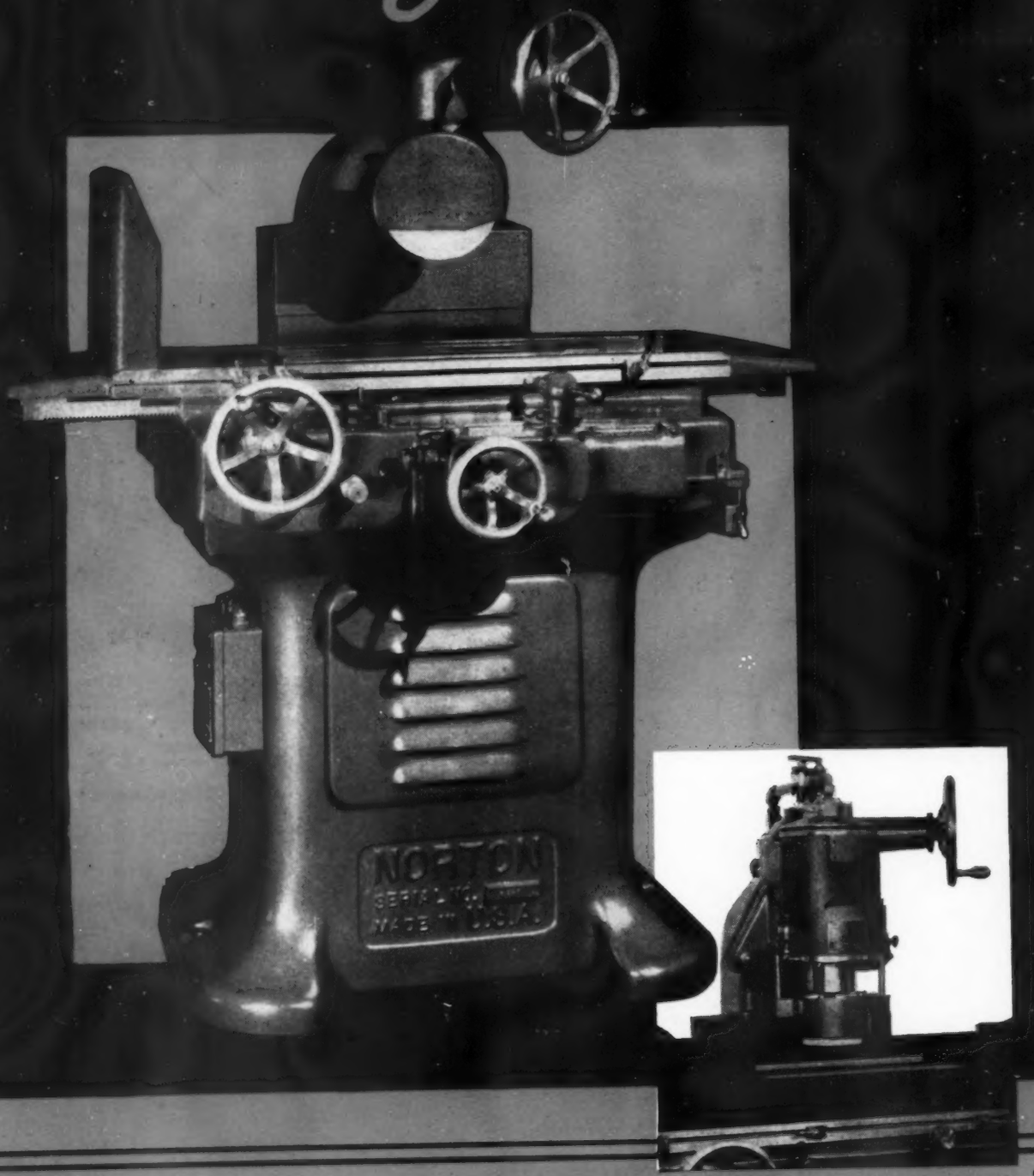
Look Ahead... Keep Ahead with Gisholt

GISHOLT

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

From Production Line to Tool Room

... the "Stuff" to do the job!



Available with either horizontal or vertical grinding wheel spindle.

The NORTON 6x18" Surface Grinder provides:

- Sturdiness and durability
- Ease of operation and control
- Dependability of NORTON design
- Accuracy with speed
- Low maintenance and operating cost
- Tested and proven in the nation's foremost plants

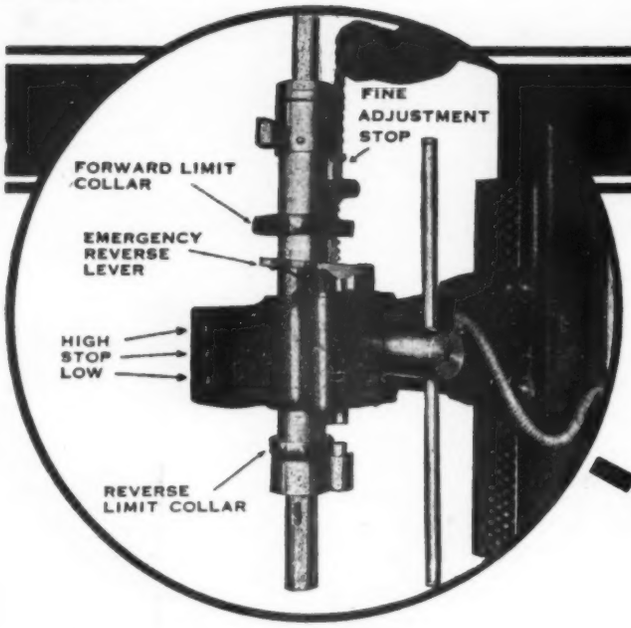
These are some of the features that have made the Norton 6" Hydraulic Surface Grinder so outstandingly popular. It is completely illustrated and described in Catalog 954. Write for a copy today — no obligation.

NORTON COMPANY, WORCESTER 6, MASS.

Distributors in All Principal Cities

M-521

NORTON GRINDERS
and Lappers



Avey FEATURE No. 1

THE Avey TYPE MA-6

AVEY-MATIC POWER FED HAND FEED AND REVERSING MOTOR TAPPING MACHINE

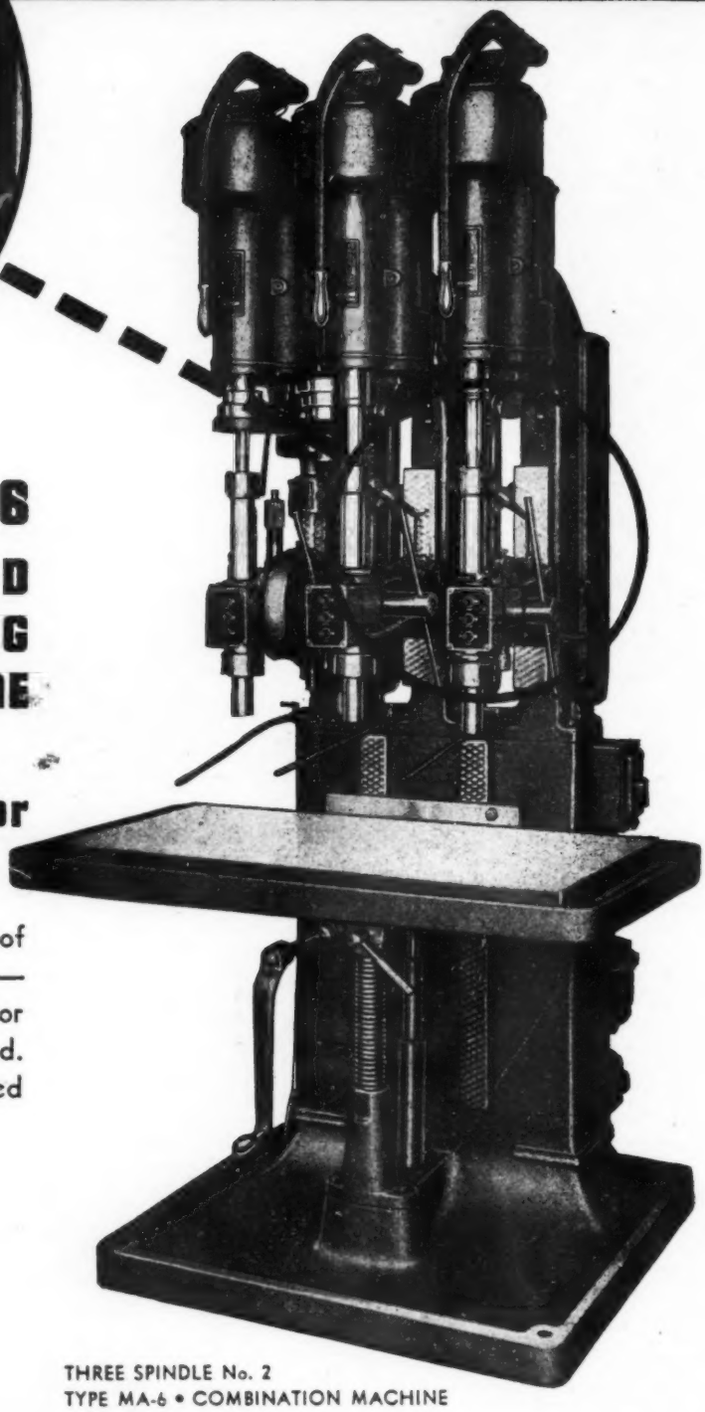
features

hand feed reversing motor for tapping

Dog control for depth — maintaining accuracy of depth within one-half revolution of the spindle — or emergency relief lever used to reverse motor if necessary before tapping cycle is completed. The natural motion of the spindle sleeve is used to control the reversing of the motor.

Type MA-6 is made in following capacities:
No. 2 — 7/8" capacity in cast iron.
No. 3 — 1 1/4" capacity in cast iron.

THE AVEY DRILLING MACHINE CO.
CINCINNATI • OHIO • U. S. A.



THREE SPINDLE No. 2
TYPE MA-6 • COMBINATION MACHINE
1st Spindle - Avey-matic Feed
2nd Spindle - Hand Feed
3rd Spindle - Tapping (Reversing Motor)

Avey DRILLING MACHINES
CINCINNATI • OHIO

BARBER-COLMAN

HOBS • HOBBING MACHINES • HOB SHARPENING MACHINES • MILLING CUTTERS
REAMERS • REAMER SHARPENING MACHINES • SPECIAL TOOLS

PROTECTO-COAT

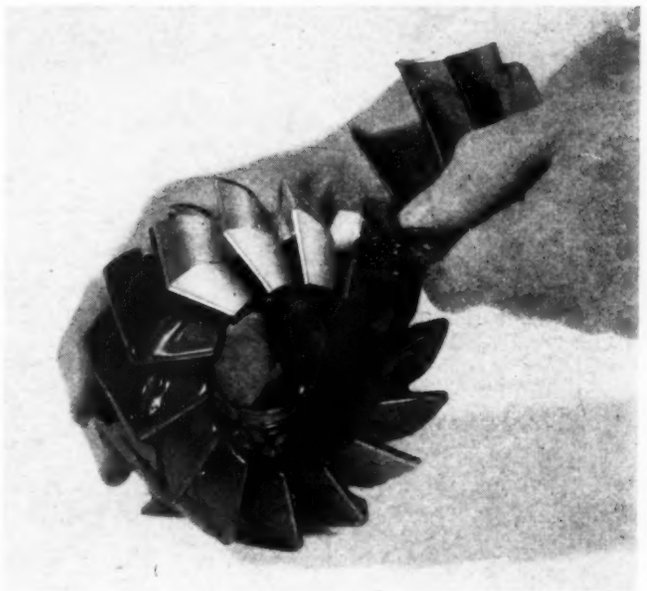
TRANSPARENT, EASY-TO-REMOVE, TOUGH CELLULOSE COATING NOW USED ON

BARBER-COLMAN CUTTING TOOLS

PROTECTS EDGES. The carefully finished cutting edges on Barber-Colman Milling Cutters, Reamers and Special Cutting Tools are protected against breakage, nicking, abrasion, and other damage by the thick, tough cover of PROTECTO-COAT.

PREVENTS RUST. The impervious covering of PROTECTO-COAT prevents rust oxidation, finger marks, or other chemical stains from marring the precision surfaces of cutting teeth. In addition, a thin film of oil is held on the tool surfaces.

PERMITS IDENTIFICATION. Unlike similar coatings, PROTECTO-COAT is clearly *transparent.* It permits easy reading of all identifying marks on the tool. Consequently, it is unnecessary to remove PROTECTO-COAT until the tool is ready for use. PROTECTO-COAT also facilitates safer and cleaner handling of tools.



PEELS OFF EASILY. By simply slitting the coating and peeling it back from the tool, PROTECTO-COAT comes off quickly, easily, and cleanly. The Half Side Mill shown above was slit around the counterbore, the outside circumference, and through one of the gashes—then the coating pulled off in one piece. *Look for PROTECTO-COAT on Barber - Colman Cutting Tools — it will be your assurance of tools received in original perfect condition.*

BARBER-COLMAN COMPANY

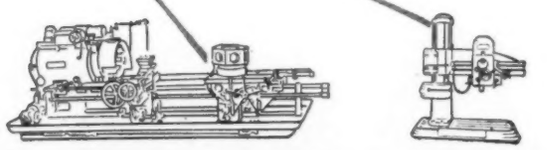
HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

GENERAL OFFICES AND PLANT • 111 LOOMIS STREET • ROCKFORD, ILLINOIS, U.S.A.

WHAT'S THIS COOLANT CALLED CIMCOOL?

HAVEN'T YOU HEARD? CIMCOOL COVERS 85% OF ALL METAL-WORKING JOBS!

Wherever production men gather—operators and foremen, superintendents and purchasing agents—the news about CIMCOOL is traveling fast! And why not? For they're learning on the production line that CIMCOOL combines high cooling capacity and high friction reduction to a degree never before attained! Yes, CIMCOOL provides higher production efficiency at lower unit cutting fluid cost...and CIMCOOL offers these advantages on 85% of all metal-working operations that require cutting fluids! *The word is getting around* in more and more plants and shops: SPECIFY CIMCOOL!



Check • Clip • Mail

AM-5

Manager, CIMCOOL Division
The Cincinnati Milling Machine Co.
Cincinnati 9, Ohio, U.S.A.

_____Please send me a copy of "What Is Cimcool?"

_____Please have sales representative call.

Name_____

Company_____

City_____ State_____

CIM

FOR HIGHER PRODUCTION EFFICIENCY - FOR LOWER UNIT CUTTING FLUID COST

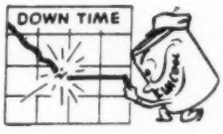
CIMCOOL helps increase production rates. Increased cooling capacity permits higher cutting speeds and feeds. Grinding wheels cut more freely. Low surface tension allows small chips and grit to settle out rapidly.

CIMCOOL is tops with operators. It restricts bacterial growth, does not contain animal or vegetable oils subject to rancidity, and is not a skin irritant. Smoke, objectionable odors and hot chips are eliminated.

CIMCOOL helps increase tool life. Chemical lubricity reduces tool wear. Tools are kept cool to touch. Increased wetting action permits greater penetration between tool and chip.

CIMCOOL is safest. Fire hazards are eliminated. Absence of slippery film on operator's hands, machine controls, work and floor reduces danger of accidents. Restriction of bacterial growth limits risk of infection.

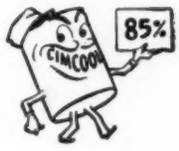
CIMCOOL reduces downtime on machines. Fewer tool changes and fewer changes of cutting fluid are necessary. Pump and supply lines are kept clean. No spoilage.

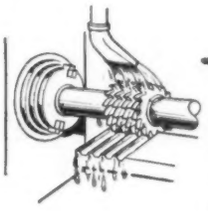


CIMCOOL contains a rust inhibitor good for the life of the fluid for protection of machine and work. It contains no chromates or highly alkaline components which may be irritating to the skin.

CIMCOOL facilitates accuracy. Freer cutting reduces pressure. Uniform temperature is maintained on work and on machine. Dirt does not stick to work or gages, permitting faster, more accurate gaging.

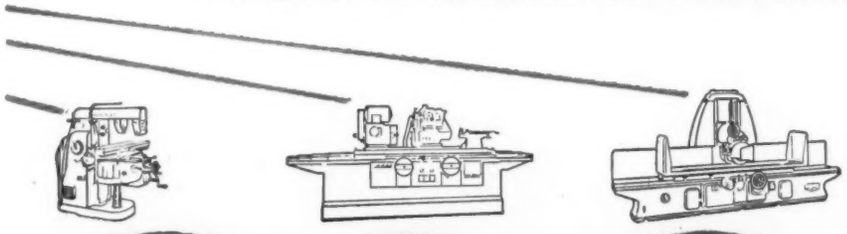
CIMCOOL is applicable to 85% of all metal-working operations requiring cutting fluids. It replaces all water emulsions and all but very highly compounded specialty oils for selected jobs.





A CASE IN POINT . . . The G. A. Gray Co., of Cincinnati, Ohio writes as follows about an operation of milling gear racks in SAE 1040 steel: "A few months ago we changed to CIMCOOL. As a result, we have saved about 100% cutter life . . . formerly in sharpening, we ground back about .008 inch per tooth, and since using CIMCOOL, this has been reduced to approximately .003 inch. At the same time, we have more pieces per tool grind. Also, cutting action of this operation was void of tearing, resulting in an improved finish."

DIVISION OF THE CINCINNATI MILLING MACHINE COMPANY • Cincinnati 9, Ohio, U.S.A.



COOL

The Multi-Purpose Cutting Fluid

Get the Jump

ON YOUR COMPETITION

LET EX-CELL-O TOOL UP A STANDARD PRECISION BORING MACHINE TO GIVE YOU *Faster Production and Lower Cost!*

Unusual adaptability makes Ex-Cell-O Precision Boring Machines suitable to a number of operations, such as boring, facing, turning, grooving. Because of their great flexibility and negligible maintenance expense, the initial cost may be spread over a variety of jobs and a long period of time. With Ex-Cell-O Precision Boring Machines, exceptional accuracy makes it possible for you to work to closer limits and assures you a better finish on your products. Their smooth, vibrationless operation means long life, minimum maintenance. Available in a variety of standard styles, Ex-Cell-O Boring Machines have fully automatic, hydraulically controlled table travel. Fast, accurate, and dependable, an Ex-Cell-O Precision Boring Machine may be the answer to your present production problems. Write today for complete details.

EX-CELL-O CORPORATION

To Right: A partial view of Ex-Cell-O Precision Boring Machine Assembly.

To Left: Ex-Cell-O Style 215-A Standard Precision Boring Machine, one of various standard styles.

EX-CELL-O *makes*

- Standard and Special Multiple Way-Type Precision Boring Machines
- Multiple Drilling and other Special Purpose Machines
- Precision Thread Grinding Machines
- Precision Lapping Machines
- Broaches and Broach Sharpening Machines
- Continental Cutting Tools
- Tool Grinders
- Hydraulic Power Units
- Grinding Spindles
- Drill Jig Bushings
- Drill Chip Breakers
- Inspection Fixtures
- Fuel Injection Equipment
- R. R. Pins and Bushings
- Pure-Pak Paper Milk Bottle Machines
- Aircraft and Miscellaneous Production Parts

DETROIT 6, MICHIGAN

MORE PRODUCTION

HOW TO GET IT IS THE *Question*

With labor and material costs rising, industry agrees that increased production is the one solution to the problem of maintaining an adequate profit margin.

But how can out-put be stepped up? Most manufacturers employ operators whose skill and long experience insure maximum volume from their present machines. The possibility of increased production through greater manual effort of these workers is slight.

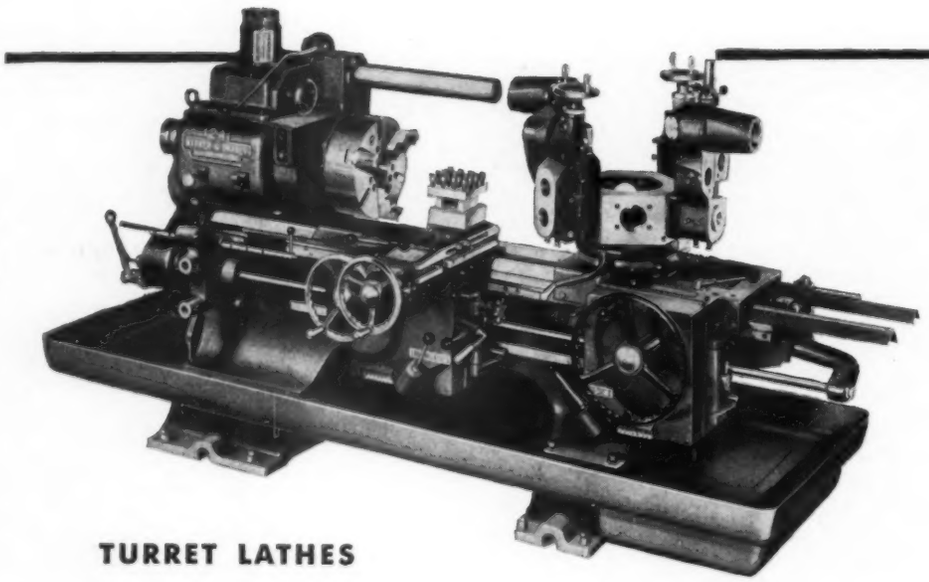
Obviously, then, the answer lies in the machines themselves.

To help you find this answer, Warner & Swasey offers new, improved machine tools . . . machines with more power for heavier multiple cuts . . . greater speed for fast production . . . and higher accuracy to produce finer finishes.

Warner & Swasey's field service can also aid in devising new tooling set-ups or the addition of accessories on old machines to increase their volume.

Whatever your problem, call for a Warner & Swasey field engineer from our nearest field office or write direct to

WARNER & SWASEY COMPANY
CLEVELAND 3, OHIO



TURRET LATHES

New Warner & Swasey Turret Lathes bring you many design improvements for increased production at low cost. Their extreme accuracy permits precision turning at high speeds. Their rugged construction makes possible heavier combined and multiple cuts. Ease of operation and control increases efficiency of the operator by cutting down fatigue.

RAM TYPES

No. 1 Electric, Bar Capacity, 5/8"—Swing, 11"
No. 2 Electric, Bar Capacity, 1"—Swing, 14"
No. 2 Six Speed, Bar Capacity, 1"—Swing, 14"
No. 3 Universal, Bar Capacity, 1 1/2"—Swing, 15 3/8"
No. 4 Universal, Bar Capacity, 2"—Swing, 18 1/8"
No. 5 Universal, Bar Capacity, 2 1/2"—Swing, 20"

SADDLE TYPES

1A Universal Heavy Duty, Bar Capacity, 2 1/2" or 3"—Swing, 16 1/4"
2A Universal Heavy Duty, Bar Capacity, 3 1/2"—Swing, 20"
3A Universal Heavy Duty, Bar Capacity, 4 1/2" or 6"—Swing, 23 1/2"
4A Universal Heavy Duty, Bar Capacity, 8", 9" or 12"—Swing, 28 1/4"

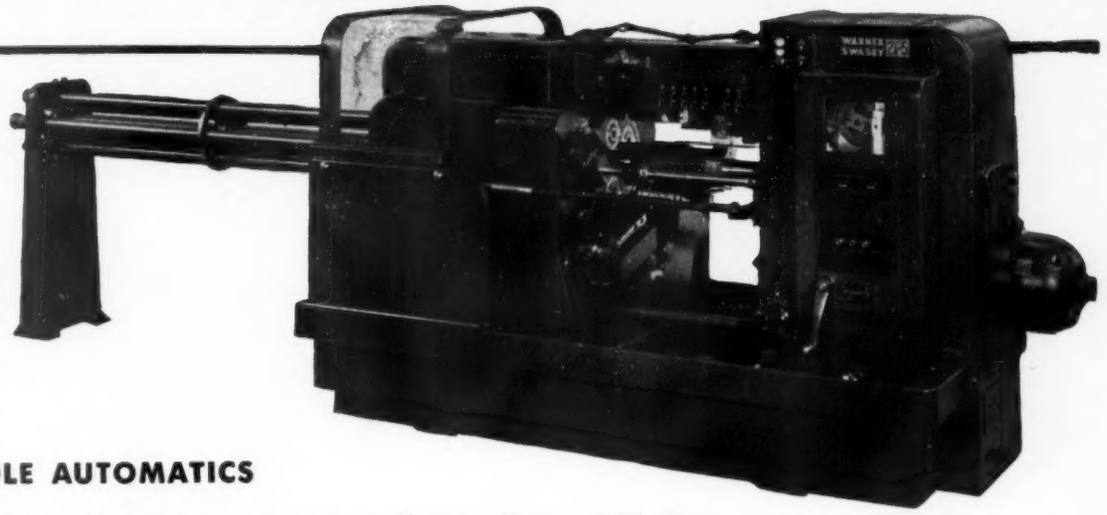
You can machine it better, faster for less.

IS THE *Answer* . . .

2 MODELS

5-Spindle Bar Machine, 1¾" Bar Capacity (Can be furnished on order with oversize spindles to handle light work up to 2¼")

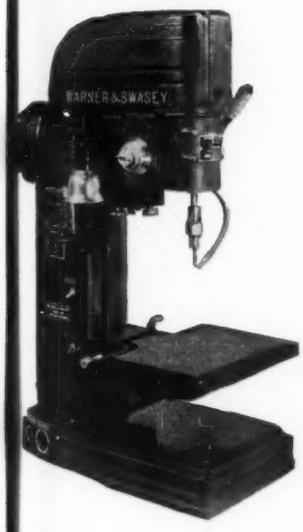
5-Spindle Chucking Machine, 6" Swing



MULTIPLE SPINDLE AUTOMATICS

Cam changes are completely eliminated on the new Warner & Swasey Bar and Chucking Automatics. New set-ups are made quickly and easily by the patented Quick-Set mechanism, making short runs, as well as medium and big lots, practical and profitable.

Investigation of these new Automatics may show that their use in your shop will result in higher volume at lower cost.



4 MODELS

No. 10 (Bench Model) Capacity No. 0-80 to 10-24

No. 11 Capacity No. 8-36 to ⅞"

No. 11R-Radial—Capacity No. 8-36 to ⅞"

No. 12 Capacity ⅜" to 2½"

PRECISION TAPPING AND THREADING MACHINES

Development of a radically new lead screw principle makes these new Warner & Swasey Tapping and Threading Machines production leaders. Elimination of backlash permits accurate threading of 3, 4 and 5 gauge fits on a production basis.

Users of these new machines tell of substantial volume increases at lower cost due to greater accuracy and elimination of tap-breakage and rejects.

WARNER & SWASEY
Machine Tools
Cleveland

. . . . . with a Warner & Swasey

Made by EXPERTS *for* EXPERTS

METRO CARBIDE TIPPED TOOLS AND PRECISION GAGES will satisfy your most exacting requirements because they are soundly engineered by men who study tools on the job. That is why they are so satisfactory to the men who use them.

• *A full line of standard tools and gages. Specials designed or made up to order. Send for catalog today.*

METRO

TOOL AND GAGE CO.

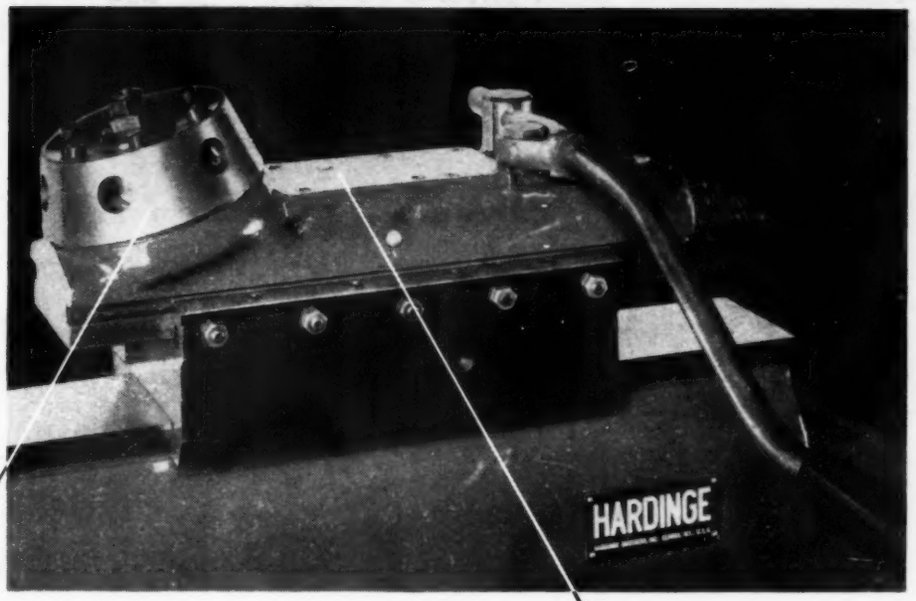
4240 Peterson Avenue

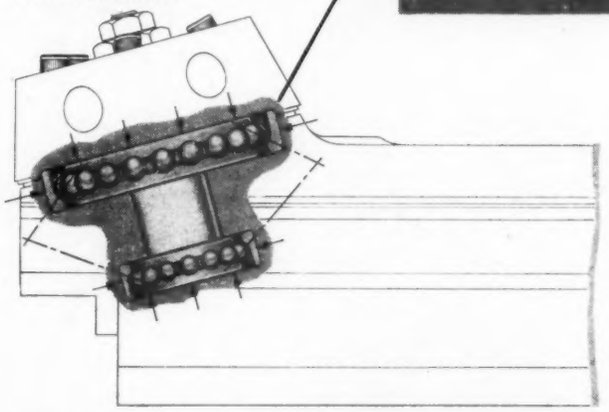
Chicago 30, Illinois

HARDINGE
ELMIRA, N.Y.

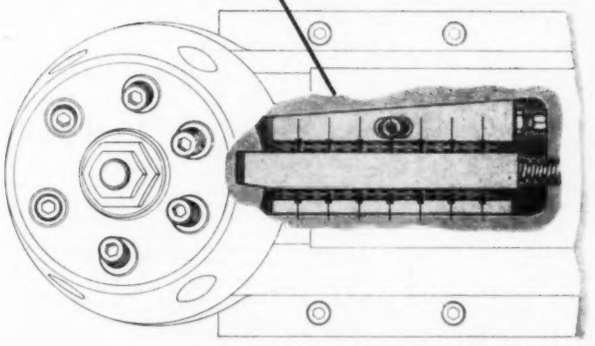
Preloaded Turret* assures accurate indexing and positive locking for Second Operation Work

*PATENTS PENDING





PRELOADED BALL BEARING TURRET HEAD — The arrows represent the preloading action which eliminates play to retain accuracy.



PRELOADED ROLLER BEARING INDEX PLUNGER — Preloading, shown by the arrows, eliminates play and retains original parallelism.

DSM 59 HARDINGE HIGH SPEED PRECISION SECOND OPERATION MACHINE

Preloading described above means that the original turret accuracy is retained regardless of day in and day out operation. The design assures turret performance equivalent to the proven performance of the preloaded ball bearing headstock spindle of the HARDINGE High Speed Precision Second Operation Machine.

The turret itself has secure anchorage to the hardened and ground steel dovetail bed. The turret slide travels on hardened and ground steel ways. The turret head and each of the six independent adjustable stops are automatically indexed to the next position, locked and unlocked, by movement of the adjustable operating lever. The use of this machine will quickly show profits in the fast and accurate production of precision second operation work.

MACHINE SPECIFICATIONS: 1" Collet capacity, 6" Step Chuck capacity, 5" Jaw Chuck capacity, Speeds to 4000 r.p.m. — Ask for bulletin DSM 59.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE

"Pep Up" Performance of Your Air Tools with CLECO ACCESSORIES

Remember the best pneumatic tools will work even better using the proper accessories from the Cleco quality line

BOWES COUPLINGS

Universally preferred for over 35 years, Bowes Couplings are used on compressed air-lines, and hose lines for gas, water, oil and liquids. Absolutely tight on pressures from 10 lbs. up, they are mechanically locked, and cannot be disconnected accidentally. A simple push and quarter twist connects, while a slight pull on locking sleeve, with a quarter turn, permits instant separation. Available in 6 styles and in many sizes from ¼" to 1½" hose or pipe ends. Supplied in bronze or "Clevetrated" steel that resists corrosion.

Ask for – BULLETIN 78A

describing these items plus Veribest Air Hose, Neverslip Hose Clamps, Hose Menders, Line Strainers, etc.

AIR VALVES. Leak-proof, non-corrosive and always air tight because the air holds the plug on its seat. No packing is used. Sizes 1" or smaller equipped with waste-port which bleeds the air from the hose when the line is shut off—a "safety-first" feature. Larger sizes so equipped on order. Handle position readily shows whether valve is open or shut.

STYLE PO
Parallel ports. Large, clean air passage; no abrupt turns to cause friction. Outlet sizes from ¼" to 1½".

STYLE SR
For vertical or horizontal pipe-to-pipe or pipe-to-hose connections. Sizes from ¼" to 1½".

STYLE A
The 30° angle valve; when connected hose-to-pipe, the former falls away free from valve. Sizes ½" to 1"

STYLE RA
For right angle connections for molding machines, manifolds, etc. Sizes from ¼" to 1".

STYLE FWL
A four-way valve. Handle movement controls supply to, and exhaust from both ends of cylinder with double-acting piston. Sizes from ⅜" to 1".

STYLE LW
Controls supply and exhaust to and from a cylinder with single-acting piston. Outlet sizes ⅜" to 1" pipe.

BLOW GUNS. Handy and economical for every foundry and shop. These guns have a shrouded thumb button to prevent breaking or bending the valve stem. Guns are rubber coated when so ordered at small additional cost. Available with drop forged stainless steel or cast bronze bodies, in ¼" and ⅜" sizes, with straight or curved nozzles. (Use Cleco Grooved Hose Nipples with these guns.)

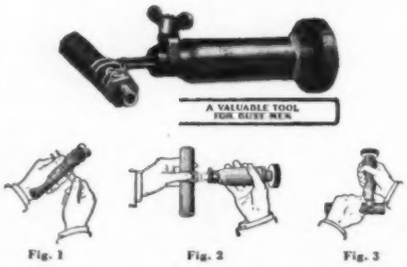


Fig. 1 Fig. 2 Fig. 3

HOSE CLAMP TOOL. This handy tool secures wire clamps to hose and fittings as follows: Fig. 1. The wire form illustrated is first placed across the hose and held by the left thumb while the right hand bends it around the hose, drawing the two loose ends through the loop. Fig. 2. The tool is then applied, the loose ends of the wire entering corresponding holes in the tool, where they are securely gripped by turning the thumb nut. Fig. 3. Turning the hand wheel forces the grooved end of the plunger against the wire loop. When the wire is sufficiently tight, the tool is turned over forward, thus securing the loose ends to the loop. The wire ends are then released and clipped off close, and finally are tapped down snugly to the hose. Wires available for hose from ¼" to 1".

THE CLEVELAND PNEUMATIC TOOL COMPANY
Branch Offices In All Principal Cities • 3781 EAST 77th STREET, CLEVELAND 5, OHIO

It is reported that . . . . . .

General Electric engineers have devised a method of measuring the temperature inside a gas turbine by making some of the parts of a special chrome cobalt alloy which changes color with increasing heat.

get ready with CONE for tomorrow

New Holland Machine Co. expects to be ready to market a new flame cultivator that is expected to weed cotton at a cost of less than fifty cents an acre.

get ready with CONE for tomorrow

Patent 2,393,594 covers the use of ammonium nitrate in liquid anhydrous ammonia as a fuel for internal combustion engines. Since this fuel contains its own oxygen, an engine using it could operate at high altitudes without dependence on the atmosphere.

get ready with CONE for tomorrow

A novel automobile, designed by Preston Tucher of Ypsilanti, Michigan, now in the road-test stage of development, is reported to have many unique features, such as front fenders that turn with the wheels, three headlights that are dimmed by a photo-electric cell, sealed radiator and center steering wheel. The two-, four- or six-cylinder opposed engine has an aluminum block and fuel injection, but no flywheel and is placed between the two rear wheels. A liquid "torque converter" replaces clutch, transmission, drive shaft and differential.

get ready with CONE for tomorrow

Businessmen will soon be offered a triangular desk made of novel woods by Fletcher Aircraft Corp. of Pasadena.

get ready with CONE for tomorrow

New York Central has a hot box alarm on its new passenger cars that signals by both smoke and smell.

Pennsylvania Railroad has a new machine that prints tickets as they are sold and also takes care of the ticket seller's bookkeeping.

get ready with CONE for tomorrow

Sacro Mfg. Corp. of Bethlehem, Pennsylvania, has an under-the-sidewalk electrical snow-melting system, designed by A. M. Byers Co., that is set in operation by the weight of snow.

get ready with CONE for tomorrow

General Electric expects to deliver the country's most powerful electric locomotive in 1946: weight 500 tons, length 143 feet, 8000 horsepower.

The Bell System will test mobile radio-telephone service for automobiles on three highways: New York-Albany-Buffalo, Chicago-Springfield and New York-Boston.

get ready with CONE for tomorrow

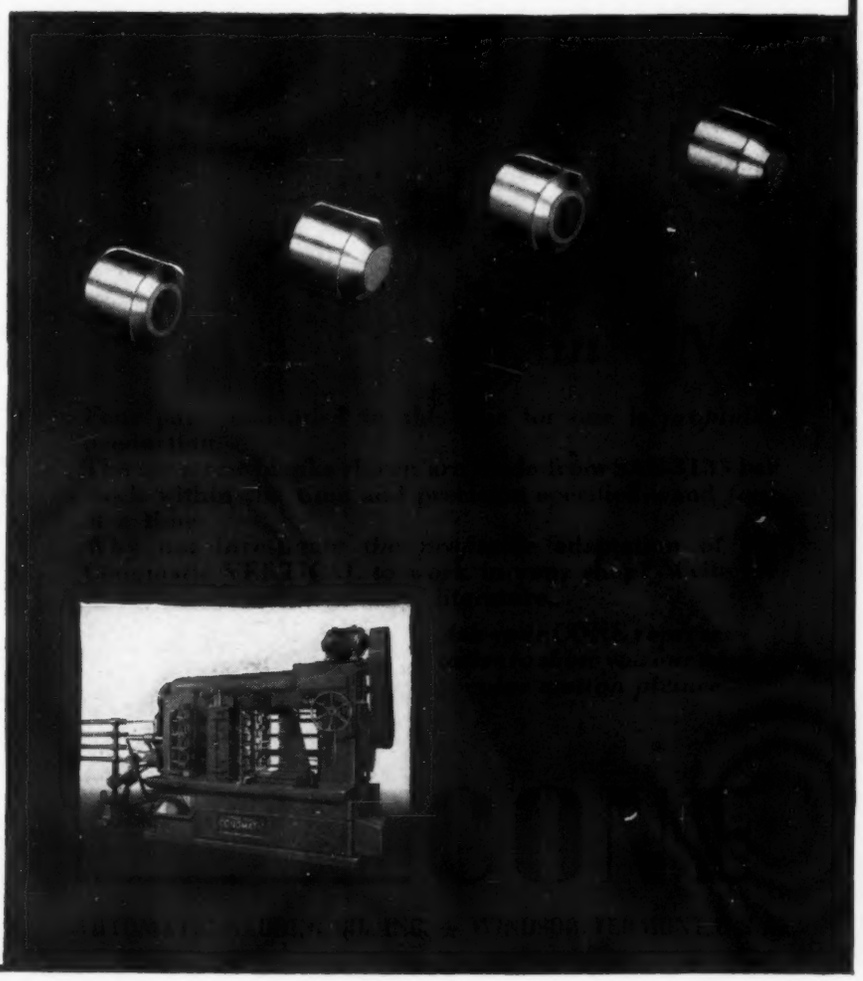
The modern trend in retail store architecture has resulted in the triple expansion of the Pittsburgh Plate Glass Company's Pittco plant, that makes metal trim for all glass store fronts.

get ready with CONE for tomorrow

One of the new ideas in jet engines, developed by Carney Associates Ltd., New York, has two cylinders firing alternately and intermittently in such a way as to make rotating parts for air supply unnecessary.

get ready with CONE for tomorrow

Pontiac, Michigan, is experimenting with a small house, one-third of which is rolled aluminum. It is not prefabricated, but built on the site.



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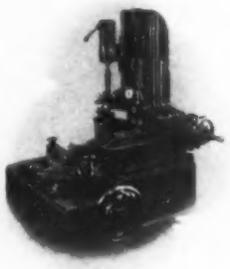
TOOLS AND FIXTURES ARE RIGHT

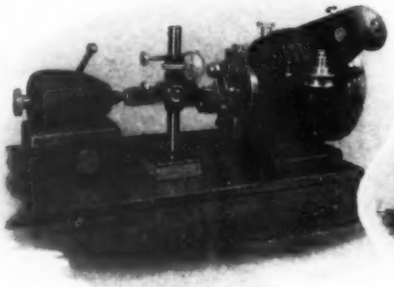
. . . And We Can Prove it!

With some of the finest checking equipment to be found in any manufacturing plant. Tooth and spline spacing, step, form, surface finish and any other characteristic that must be closely held is thoroughly and accurately checked by skilled inspectors. The result is tools and fixtures that are ready to run when you get them. Last minute adjustments on the job are cut to a minimum. Set-up time is reduced.

Call Detroit Broach for complete broach service that is right from design to actual production.



Involute Checker for checking involute tooth form.



Optical Dividing Machine for checking index.

Surface Analyzer for checking tool and broached part finish.

Optical Comparator for checking irregular forms.

MEMBER BROACHING TOOL INSTITUTE

DETROIT Broach COMPANY

20201 SHERWOOD AVENUE • DETROIT 12, MICHIGAN

Thread rolled...

HOLLOW PARTS
SOLID PARTS
FORMED PARTS
SERRATED PARTS

SMALL DIAMETERS
LARGE DIAMETERS
JUST CHANGE THE ROLLS

CLASS 4—AND BETTER
MIRROR FINISH
GREATER STRENGTH

SOFT METALS
HIGH TENSILE ALLOYS
STAINLESS-MONEL

ON

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THREAD GENERATORS

DEMONSTRATION AT YOUR CONVENIENCE

TO AIRCRAFT TOLERANCES WITH UNSKILLED HELP

This machine ensures not only greater accuracy, but also better finish, greater strength and higher production.

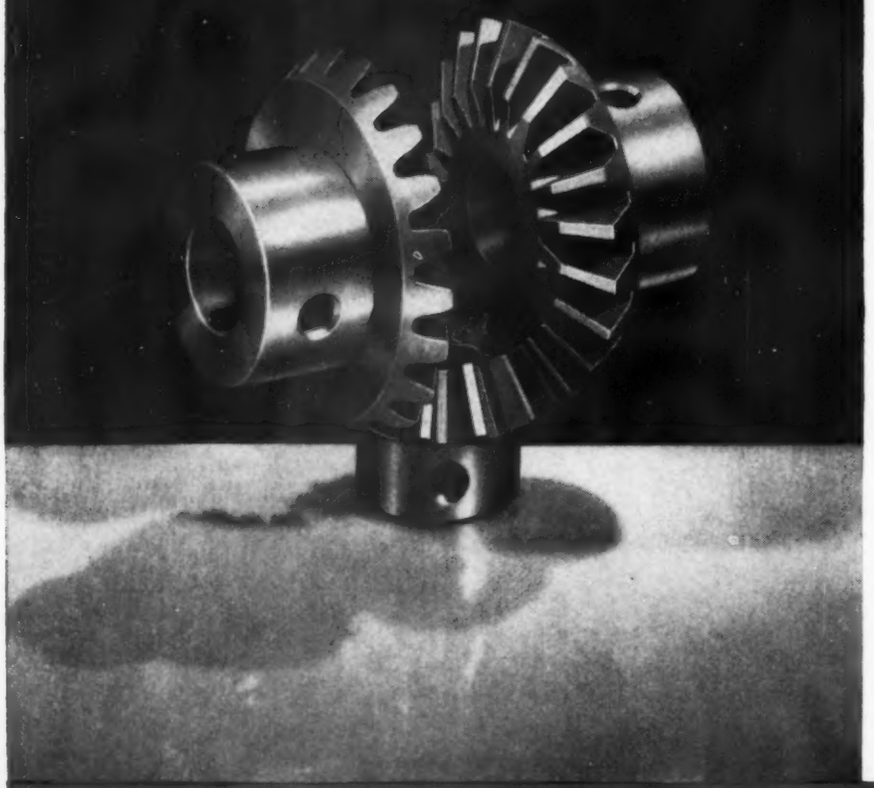
High tensile alloy steels and stainless steels can be effectively thread-rolled on this machine, and the simple design and arrangement of the controls enables unskilled help to secure results of the highest accuracy and finish.

THE Steinle MACHINE COMPANY

HARTFORD, CONNECTICUT

IF IT'S A SMALL GEAR PROBLEM

Ask G S FRACTIONAL HORSEPOWER GEARING



Many of America's most critical buyers specify *"G.S."* when they want small gears. They have learned to depend upon our craftsmen for a degree of *uniform* excellence unequalled in the history of small gear manufacture. You see, G.S. *specializes* in the design and manufacture of Fractional Horsepower Gears exclusively! Our entire time and effort is devoted to doing this one job *better*. If you have a plan or a product in which the quantity production of precision small gears is involved, for your own best interests discuss it with a G.S. engineer. Discover the unusual efficiency and economy of our methods developed thru a quarter century of intensive specialization in custom-building Fractional Horsepower Gears.

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WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARS

Proven quality and dependability of performance are hallmarks of the products of the Mid-West Abrasive Company.

Mid-West's outstanding successful tool room grinding wheel, and every other product of the broad Mid-West line—honing stones, sharpening stones, coated abrasives, disks and wheel dressers—all must bear these two hallmarks.

Let engineered quality and dependability guide you in your choice of abrasives, and we feel certain that choice will be Mid-West. Prompt delivery on all items.

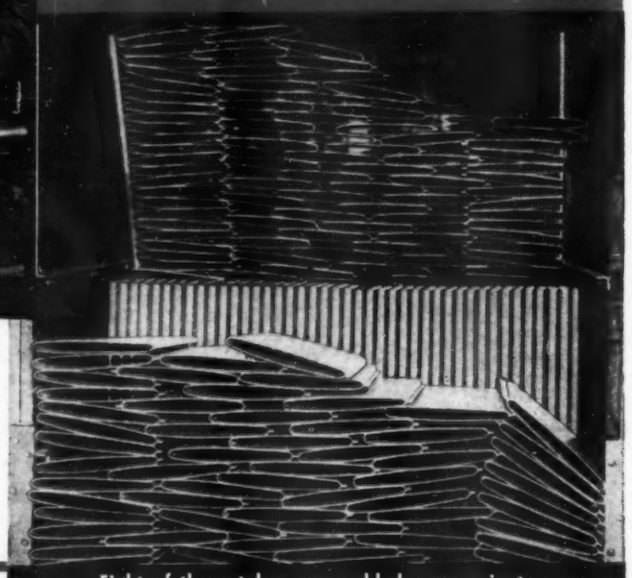
MID-WEST ABRASIVE CO.

Manufacturers of DEPENDABLE Abrasives

Owosso, Mich. • Detroit • Rochester, Pa.

Welding tube sections at the Reznor plant

1500% INCREASE in OUTPUT



Eight of these tubes are welded every minute

. . . made possible by electronically controlled resistance welding . . .

Heat-exchanger tubes are now produced by the Reznor Manufacturing Co., Mercer, Pa., at *16 times* the former rate, using seam welding.

While one operator could produce only *30* tubes an hour by gas welding, he can now complete *480*—or a total of 45,000 inches of weld.

This is just one striking example of the boosts in output possible with seam welding.

Why ELECTRONIC Control Was Chosen

Basically a fast process, seam welding is speeded up even more by electronic control. With this type of control it is possible to interrupt the welding current consistently up to 1800 times in a *single minute.*

Equally important is the fact that electronic seam-welder control, with its synchronous-precision timing, helps assure high-quality welds.

Electronic control is quiet operating, too. The welding current is controlled by noiseless electronic tubes. And because there are no contacts to replace, maintenance cost is low.

If you'd like more information about electronic seam-welder control, ask our local office for a copy of Bulletin GEA-4220. Our engineers will be glad to help you with your application. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

REDUCED KVA DEMAND

This electronic seam-welder panel used in the Reznor plant offers an additional advantage—it is designed for use with series capacitors to provide power-factor correction. This combination makes possible a material reduction in demand on the power supply—an important saving in all industries.

G-E RESISTANCE WELDING CONTROL

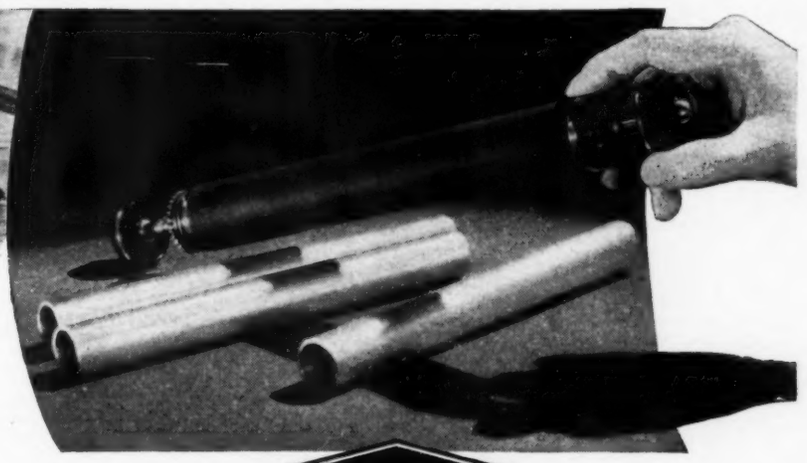
GENERAL ELECTRIC

"—but there's no work to punching a typewriter"

Swinging an air hammer spells l-a-b-o-r to its operator. The typist's job looks like child's play to him. But try pushing a heavy typewriter carriage back all day long, and you'll know you've been at work.

American Magnesium products have helped ease both tasks. Air hammers, and many other hand tools, have been lightened considerably with magnesium parts. The typewriter roll pictured here has a feather-weight magnesium core.

Manufacturers interested in lightening their products with magnesium will find our engineers and production men ready to help. Get in touch with the nearby Alcoa office. Or write ALUMINUM COMPANY OF AMERICA, 1709 Gulf Bldg., Pittsburgh 19, Pa.



MAGNESIUM MAZLO PRODUCTS

AMERICAN MAGNESIUM CORPORATION

SUBSIDIARY OF ALUMINUM COMPANY OF AMERICA

SOUTH BEND
Precision Lathes

RUGGED
ACCURATE
DEPENDABLE

The rugged construction of South Bend Precision Lathes is best demonstrated by the fact that the great majority of all South Bend Lathes ever made still are giving satisfactory service after years of daily use. Their rugged construction explains why, even after many years of service, they continue to produce toolroom and production work to close tolerances. It explains, too, why they have earned for themselves a reputation for dependable performance in all types of installations which are representative of modern industry. Because of their rugged construction, lifetime accuracy, and dependability, plus unusual versatility, you will find it to your advantage to specify South Bend Precision Lathes for your next installations. Write today for Catalog 100-D which illustrates in color and describes all South Bend Precision Engine Lathes, Toolroom Lathes, and Turret Lathes.

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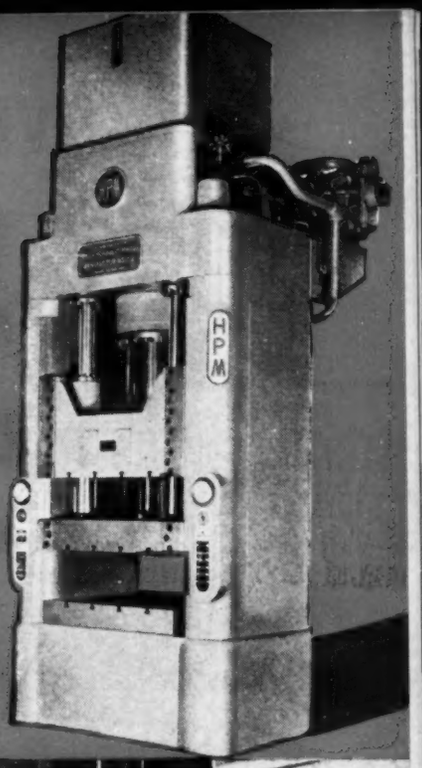
LATHE BUILDERS SINCE 1906

H·P·M Hydraulics

LOWER PRODUCTION COSTS OF HOUSEHOLD APPLIANCES!



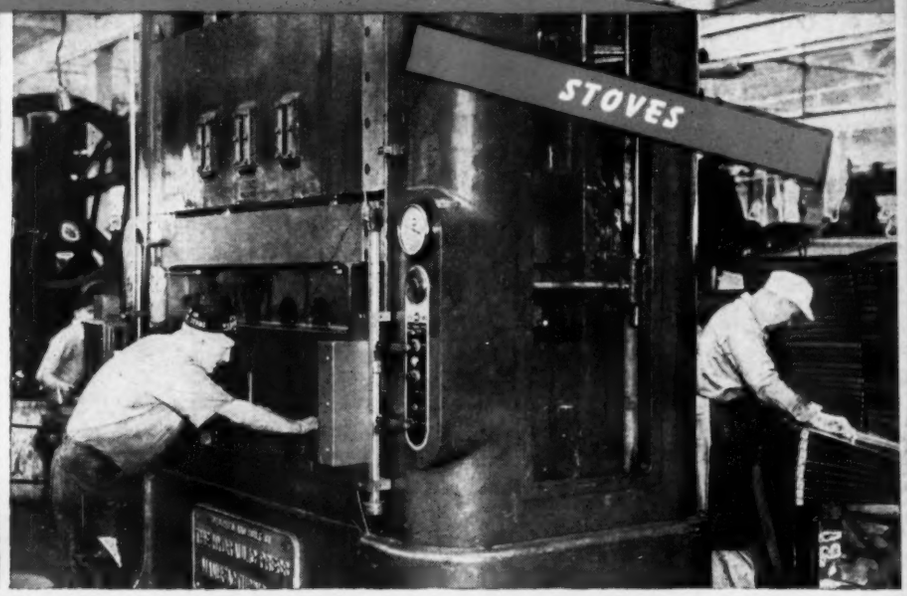
Appliance manufacturers who are using H-P-M FASTRAVERSE deep sheet metal drawing presses are obtaining the following cost saving results . . . deeper draws, fewer rejects, less maintenance and a constant high production output. It is an undisputed fact that the hydraulic press is the ideal production tool for drawing sheet metal. When choosing your hydraulic press, ask yourself these questions: Are you buying the most modern self-contained type? Is the press universal, and therefore adaptable to numerous forming and drawing operations? Are the hydraulic components — pumps, valves and controls manufactured by the press builder, thus guaranteeing you undivided responsibility?

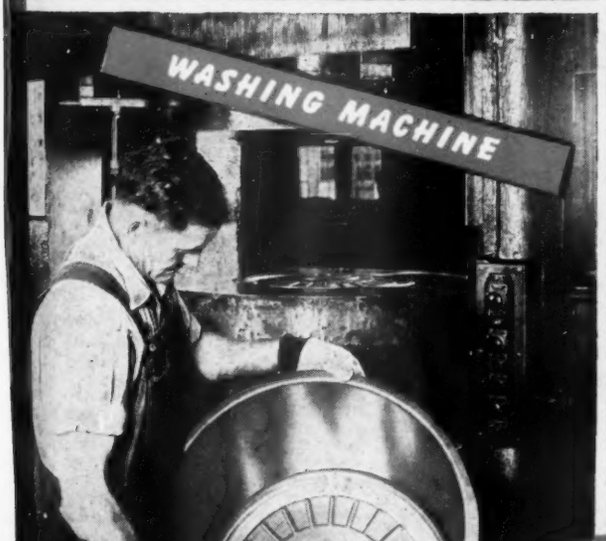
When you install H-P-M presses, you gain all of these advantages plus sixty-nine years of specialized hydraulic press experience. Call in an H-P-M engineer to study your particular metal working problem.

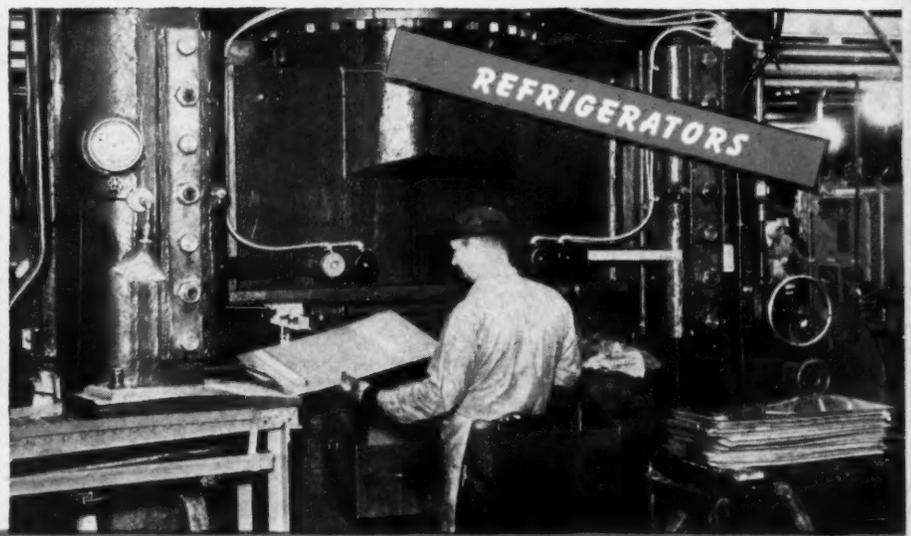
THE HYDRAULIC PRESS MFG. CO., *Mount Gilead, Ohio, U.S.A.*

BRANCH OFFICES IN NEW YORK, PHILADELPHIA, CLEVELAND, CINCINNATI, DETROIT, AND CHICAGO

REPRESENTATIVES IN OTHER PRINCIPAL CITIES







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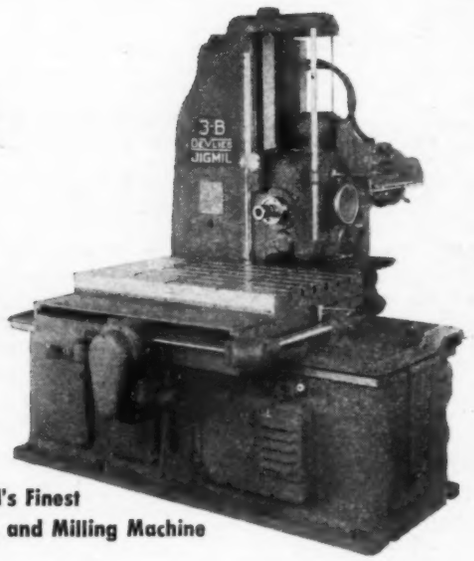
REVOLUTIONIZING PRODUCTION WITH HYDRAULICS SINCE 1887

All Hydraulic-Self Contained

FASTRAVERSE PRESSES FOR SHEET METAL DRAWING

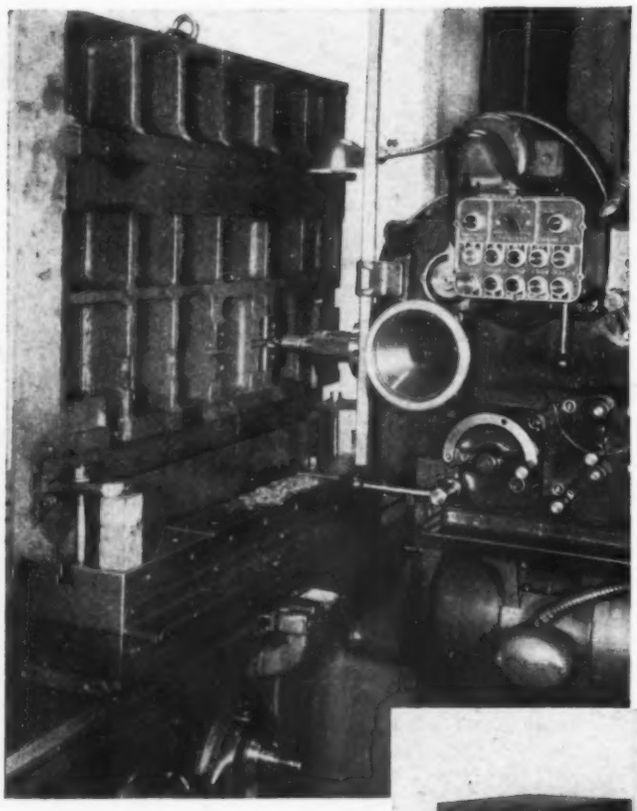
3-B DeVlieg JIGMIL Gives You Great Versatility with Accuracy in Extended Range Operation



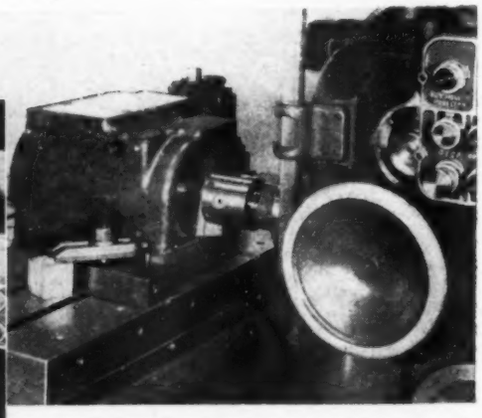
The World's Finest Jig Boring and Milling Machine

The 3-B DeVlieg JIGMIL maintains its high standard of accuracy over the full range of its generous specifications. This unmatched combination of versatility and accuracy makes the JIGMIL capable of handling a greater range and variety of precision jig boring and milling operations.

In addition, JIGMIL's high precision performance through centralized push button controls results in two to three times the output and higher quality work with ordinary skill and greatly reduced cost per unit.



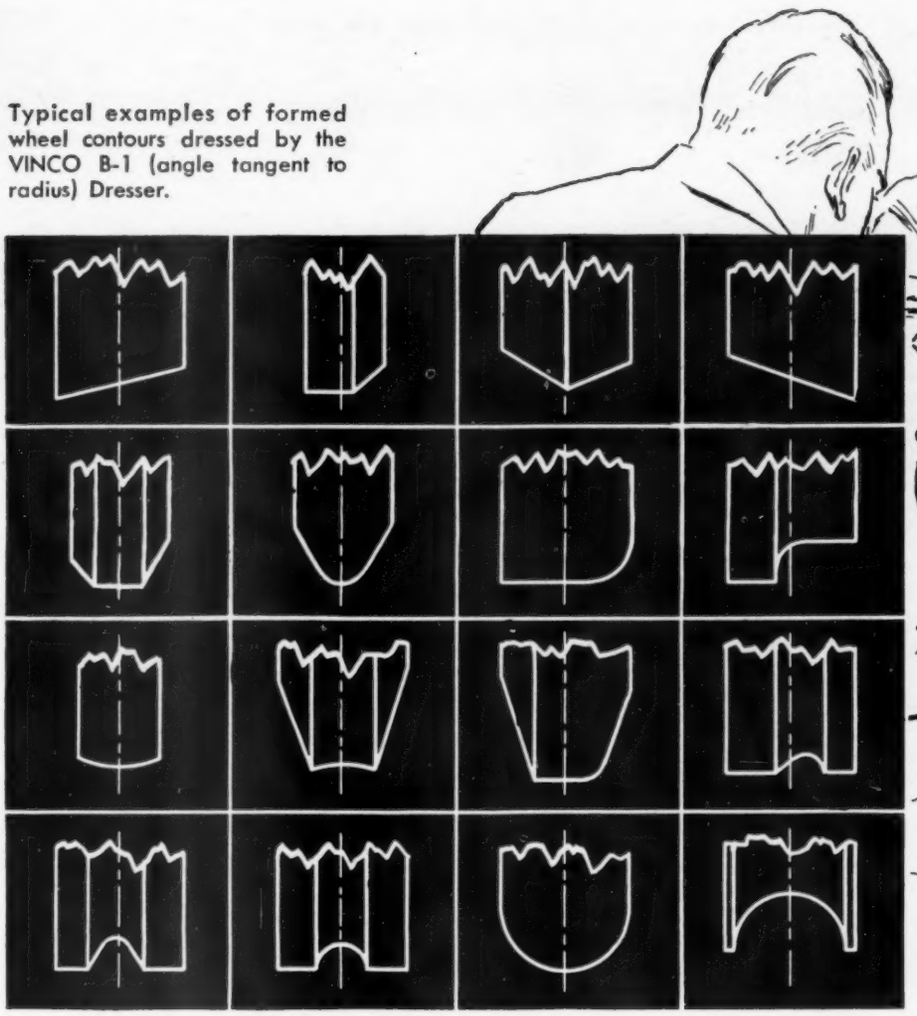
JIGMIL CAPACITY TO HANDLE LARGE HEAVY WORK is illustrated by the slot milling operation above. Work piece is 48" long, 40" wide and weighs 1700 pounds. **IN CONTRAST, THE HEAVY MILLING OPERATION** at right demonstrates the JIGMIL'S unusual versatility in milling performance. Here a 10" diameter face mill takes a roughing cut on a tough steel casting. Note the clean chips, the depth of cut. Both operations were rapidly performed by means of centralized push button controls.

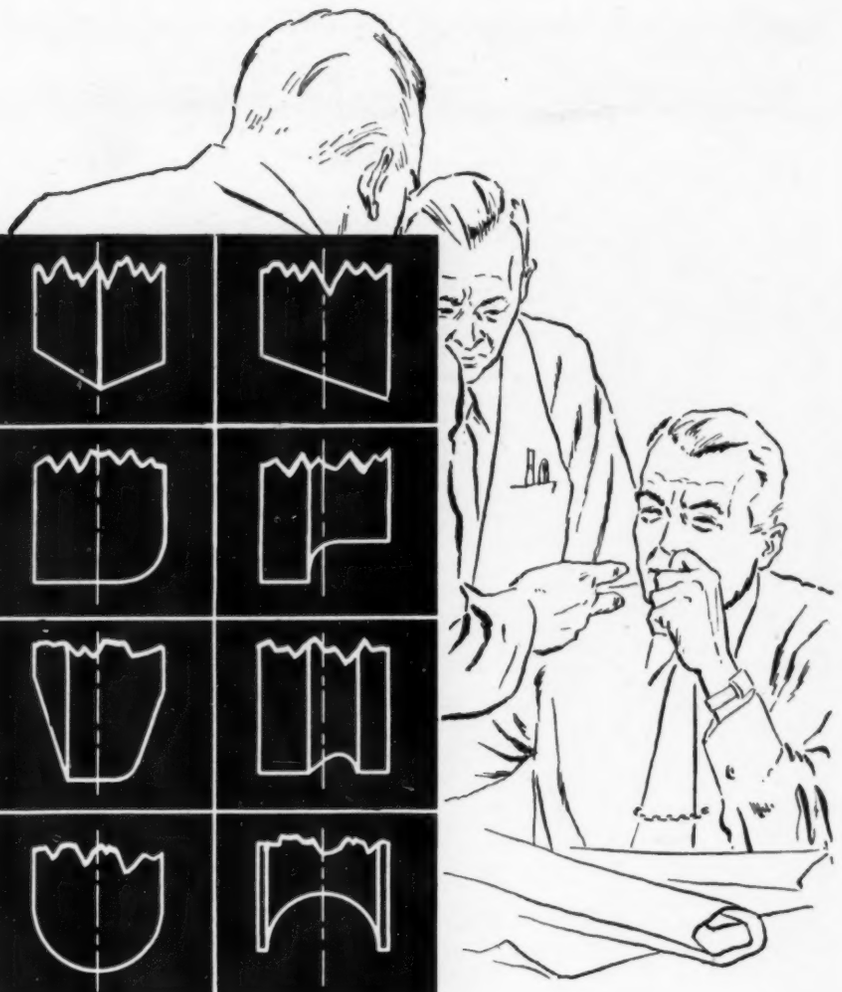


PRECISION BORING THE JIGMIL WAY! Work piece hole diameter is 5.7" by 14" long. Required limits for the job . . . size and length . . . were .0005". With JIGMIL precision, JIGMIL accuracy in extended range operation, limits were actually held to within .0001" round, diameter and straight!

DeVLIEG MACHINE COMPANY DEVLIEG JIGMIL **450 FAIR AVE. FERNDALE 20, (Detroit) MICH.**

Typical examples of formed wheel contours dressed by the VINCO B-1 (angle tangent to radius) Dresser.





They Came to VINCO

With a wheel dressing problem familiar to everyone in the Gear Grinding Industry. To insure a dependable precision production program, this well known manufacturer needed a formed wheel dresser that could automatically dress the wheel so it would consistently grind a true involute profile.

So They Came to VINCO!

We designed and made a single purpose dresser that eliminated any heel or toe action of the diamond post, was adjustable for either a rough or finish cut, and would dress a true radius with a speed and accuracy hitherto unobtainable by such a simplified method. *Regardless of the experience of the operator* the results obtained were more than satisfactory.

Check this type of development with relation to your own precision grinding problems. Full information will be furnished upon request.

MILLIONTHS OF AN INCH FOR SALE BY VINCO

REG. U. S. PAT. OFF.

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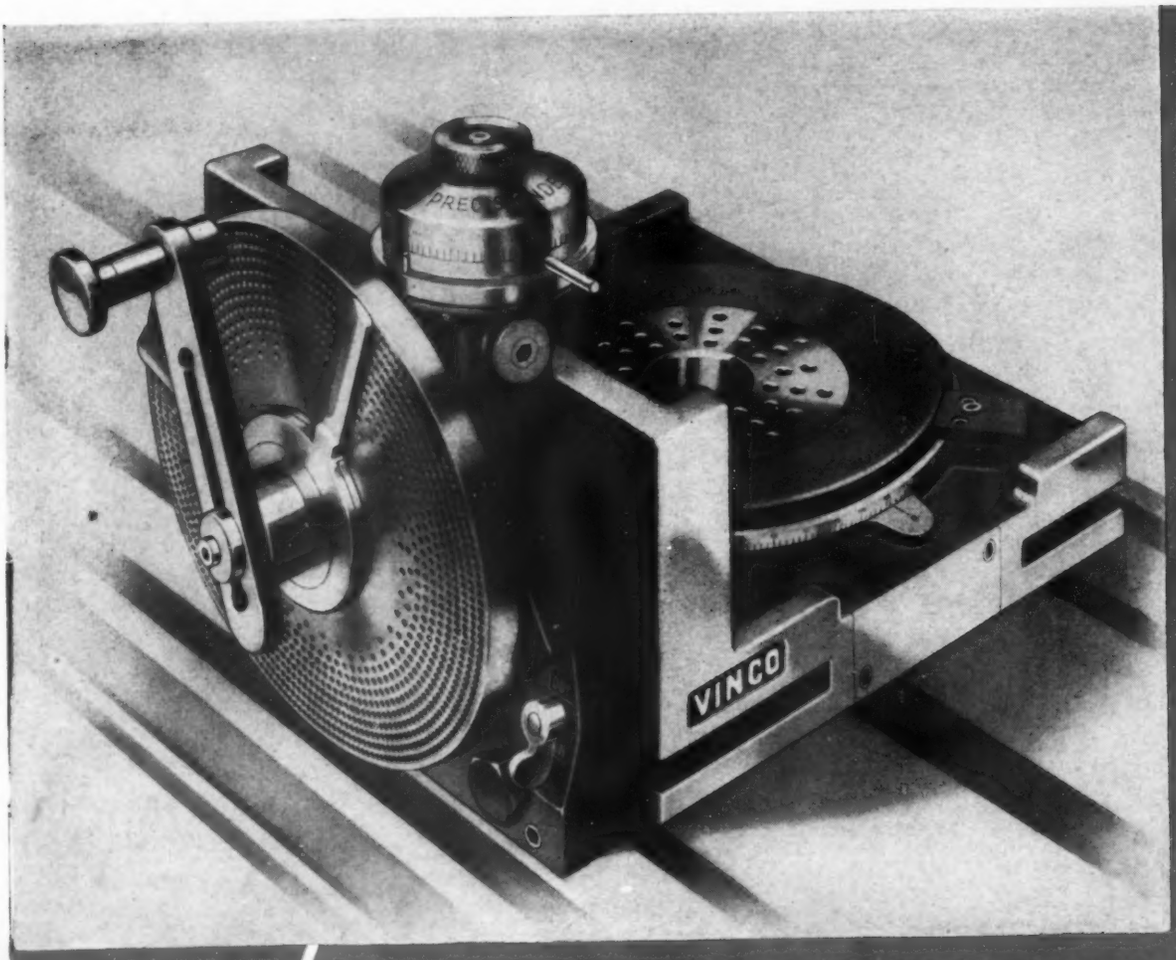
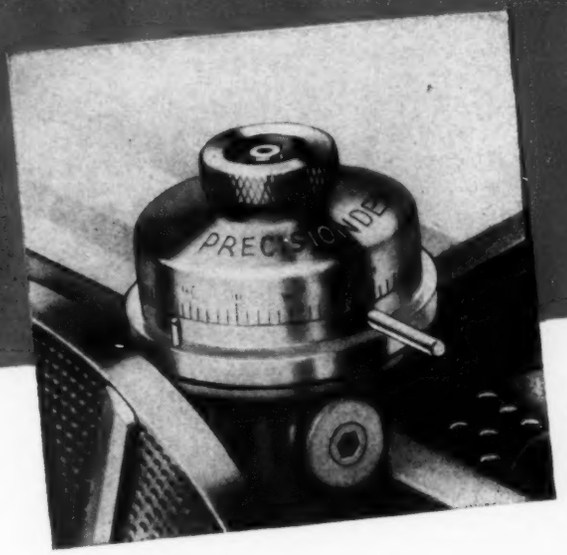
Semi-Automatic Hydraulic Spline and Gear Grinder • Optical Master Inspection Dividing Head • Involute Checker • Angle Tangent to Radius Dresser • Index Plates • Precision Vises • Sine Bars • Straight-side Spline, Serration Spline, Involute Spline and Helical Spline Plug and Ring Gages • Plain Cylindrical Plug and Ring Gages • Thread Plugs, Rings and Setting Plug Gages • Spur and Helical Master Gears • Munition Gages • Propeller Shaft and Hub Gages • Built-up and Special Gages • Gear Rolling Inspection Fixtures • Indexing Fixtures • Hydraulic Power Control, Utilization and Distribution Units • Engineering, Design and Development • Precision Production Parts.



NEW

Jerry the grinder says:
"Pleased with the VINCO Precisiondex????
I'm tickled pink!!!!!"

Close-up shows the micrometer assembly. All that is necessary, after the dial is turned to the desired seconds reading, is to move the handle and you accurately index the set amount each time without further adjustment.



VINCO PRECISIONDEX

- CIRCULAR DIVISIONS IN DEGREES, MINUTES AND SECONDS.
- INDEXING ACCURACY TO WITHIN 20 SEC. OF ARC. IDEAL FOR INSPECTION PURPOSES.
- FIXTURE CAN BE USED IN ANY ANGULAR POSITION FROM HORIZONTAL TO VERTICAL.
- SPINDLE MOUNTED IN VINCO PRECISION BALL BEARINGS.
- SPINDLE, FACE PLATE AND INNER BALL RACE ARE OF ONE-PIECE CONSTRUCTION.
- SPINDLE CAN BE CLAMPED FOR MILLING OR BORING.
- ROTATION OF SPINDLE CONTROLLED TO ONE SECOND OF ARC.
- 11½" WORK SWING.

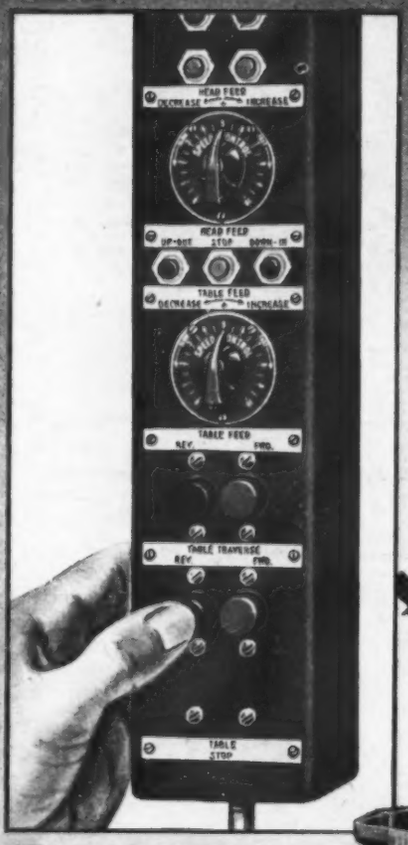
For complete details ask for bulletin No. 55A.

VINCO CORP., DETROIT 27, MICHIGAN

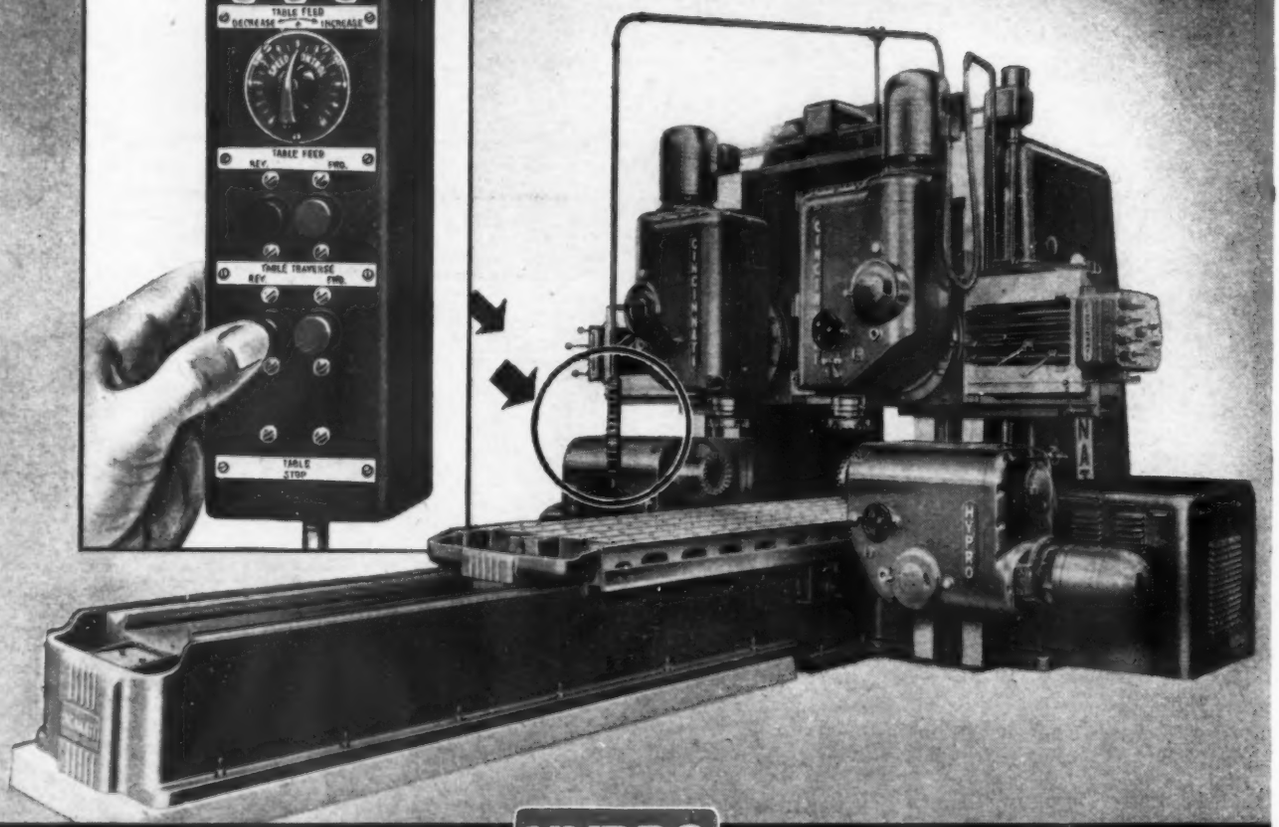
240 to 1 SPEED RATIO...

Hypro·electronic

PLANER-MILLER DRIVE



240 to 1 speed ratio on all head and table feed rates. Completely adjustable from pendant station without gear changes.



THE CINCINNATI HYPRO PLANER COMPANY

PLANERS · BORING MILLS · PLANER TYPE MILLERS

CINCINNATI, OHIO

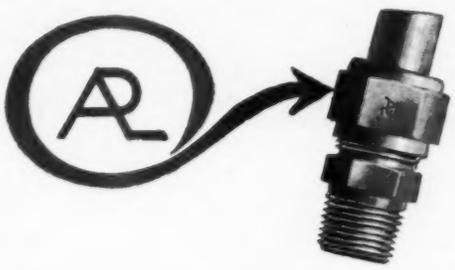
Select

THE TUBING THAT FITS THE JOB AND

THE COUPLING THAT FITS THE TUBING

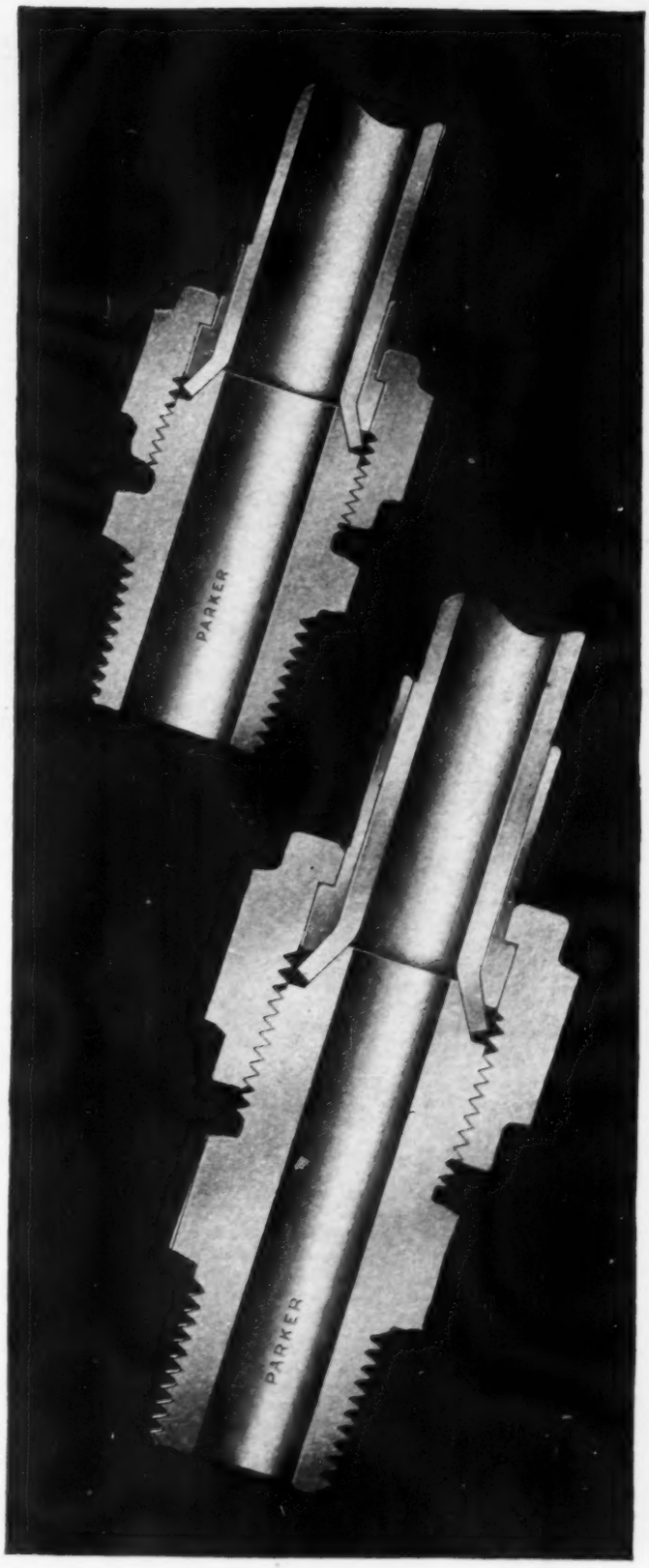
That's sound engineering—sound Fluid Power engineering. It means a tubing system that insures smooth, streamlined flow, with leak-tight and vibration—proof joints, plus easy installation and maintenance.

The Parker trade mark is your assurance of getting exclusive and patented Parker design features that set the standard for Army-Navy aircraft and ordnance use.



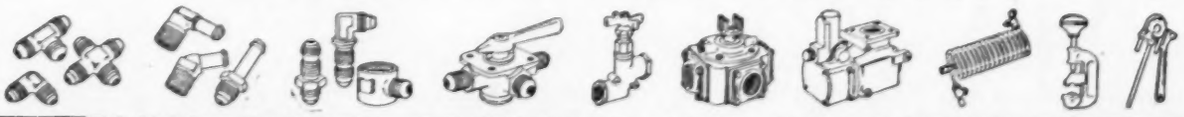
Note particularly the angle of the flare. It is scientifically set to provide maximum clamping surface, with equalized pressure all around. All stress and strain are taken on the body, nut and sleeve—there is full protection for the system against shock and vibration.

Catalog 201-C gives complete data on *standard weight* and *heavyweight* triple couplings —1/8" to 1½"—in steel, brass, stainless steel and aluminum. Ask your jobber or write to The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.



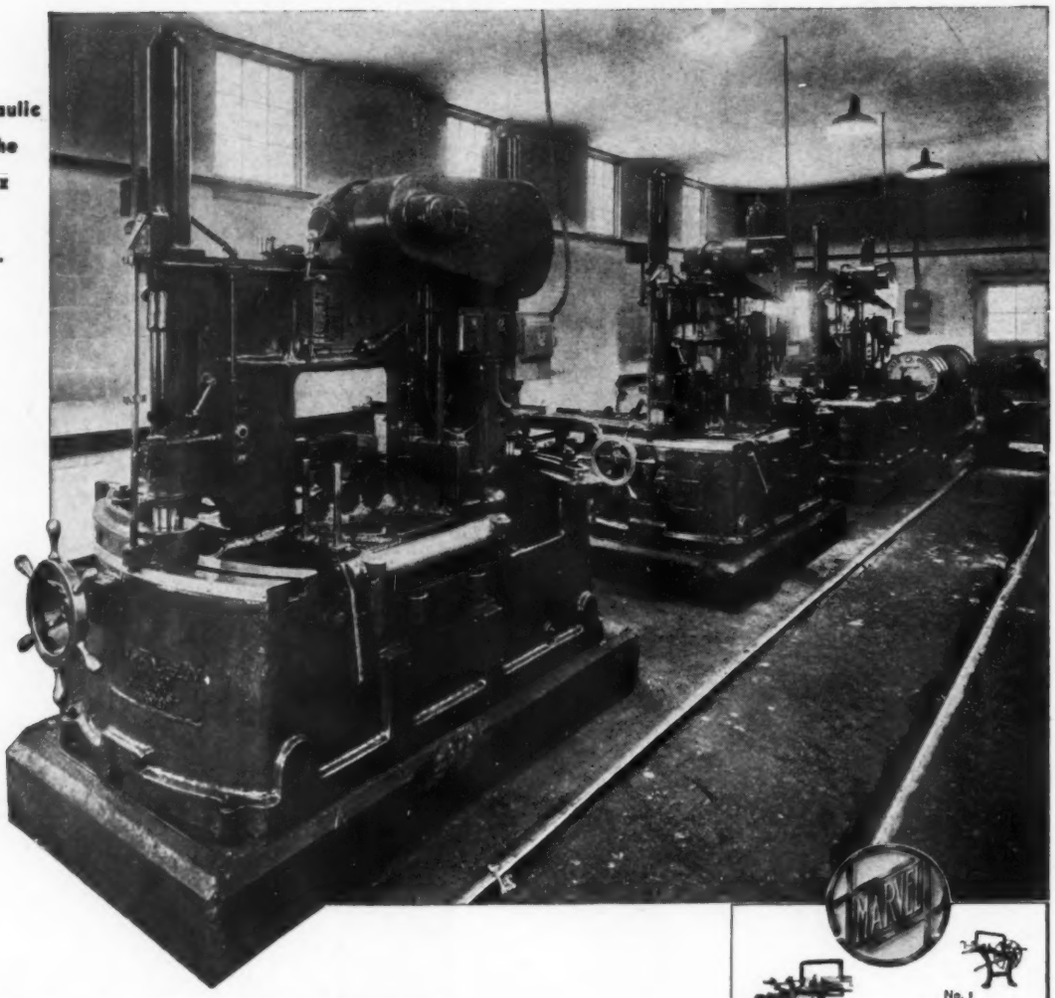
THE PARKER APPLIANCE CO.

CLEVELAND • LOS ANGELES



FLUID POWER PRODUCTS FOR ALL INDUSTRY

3 MARVEL $18 Hydraulic Hack Saws at the Babcock & Wilcox Tube Co.— Beaver Falls, Pa.



EASILY CUT-OFF TOUGHEST STEELS

Steels just don't come too tough for MARVEL Giant Hydraulic Hack Saws. Take, for example, the three No. 18 MARVEL Saws, at the Babcock & Wilcox steel mill, shown above. These machines are used to cut test specimens from sample pieces of stainless and other tough alloy billets which are checked for seams, pipes, etc., before being drawn into tubing. It takes tough steel to make the best tubing, and it takes modern sawing equipment to cut it rapidly, accurately and economically.

With 10 types of metal-cutting saws, each available in a series of variations, MARVEL can furnish sawing machines that exactly meet your requirements. If you have a metal-sawing problem—call in the local MARVEL Sawing Engineer.

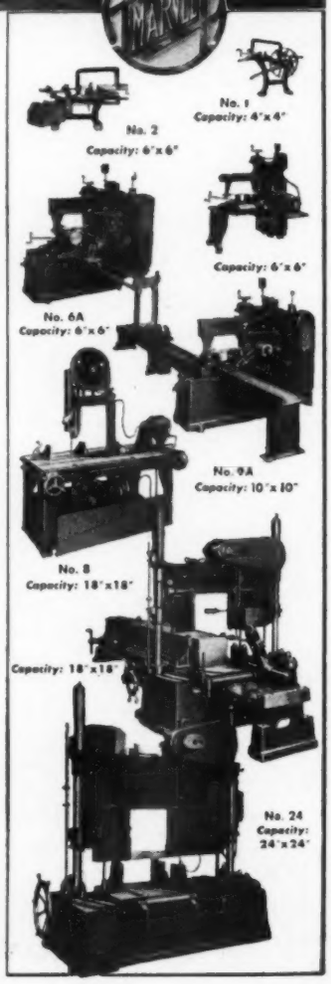
Write for MARVEL Catalog or check it in your Sweet's Catalog Files

ARMSTRONG-BLUM MFG. CO.

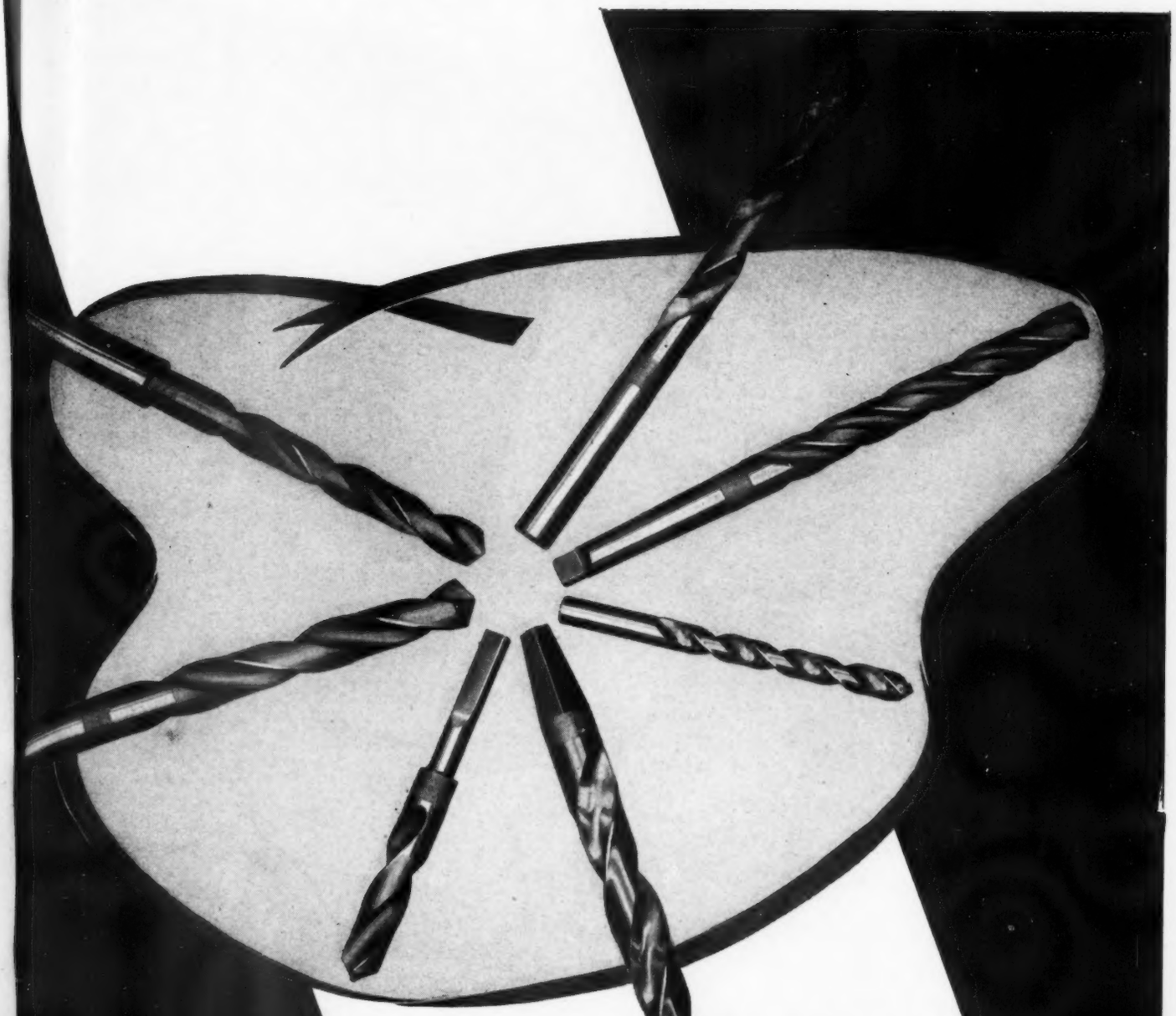
"The Hack Saw People"

5700 BLOOMINGDALE AVENUE CHICAGO 39, U. S. A.

Eastern Sales Office: 225 LAFAYETTE ST., NEW YORK 12, N. Y.



MARVEL SAWS



..by UNION

Progress in drill design and manufacture is most apparent in results obtained, not in the laboratory, but on the job. That is where Union Twist Drills have proved their production ability. For the progress you want in your production, stick with the tools that are produced for progress. Choose Union — The Tools You Buy Again.

UNION TWIST
DRILL COMPANY
ATHOL, MASS.

UNION ★ BUTTERFIELD ★ CARD Divisions of the Union Twist Drill Company

BUTTERFIELD

THRED-RITE DIES AND HOLDERS

THRED-RITE Adjustable Collet Dies and Holders are economical, fast, accurate! Top-quality results are assured. Carbon steel and high speed steel. NC and NF threads. All standard sizes.

These Butterfield Tools are made of the finest carbon steels and high speed steels – available in a complete range of types and sizes. Accurate! Long-lived! Dependable!

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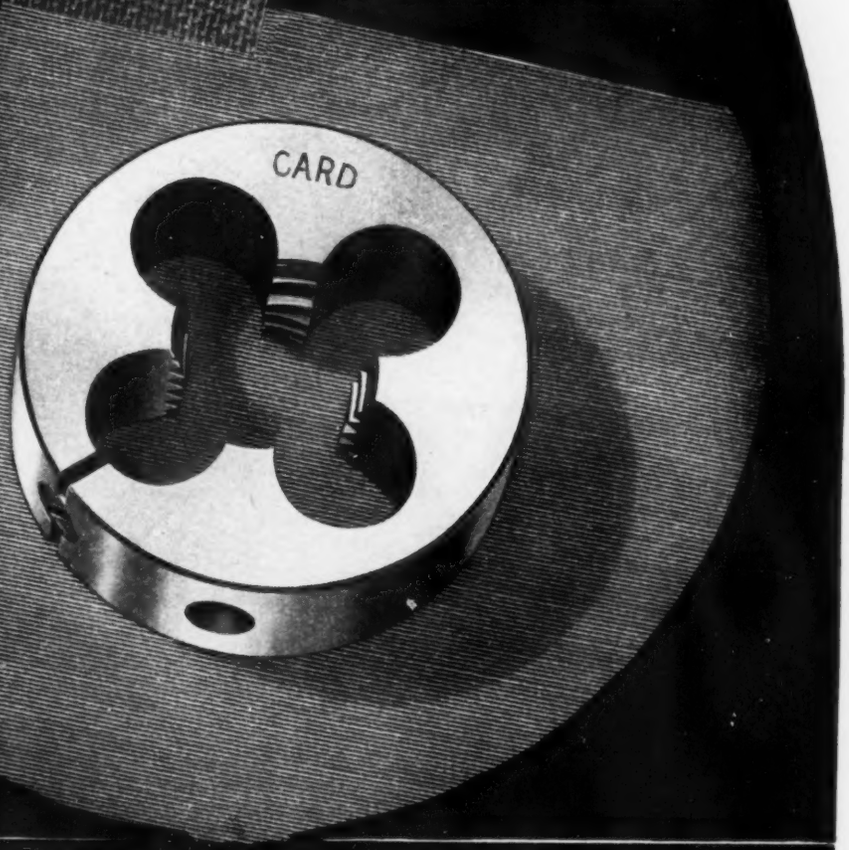
CARD

TAPS
IN ALL SIZES

— and in all styles! Choose your Taps for greatest peacetime production from the complete line made by the Card organization of tap experts.

Round DIES

Card Adjustable Round Split Dies are carefully produced of hardened tool steel, adjustable by the simple use of a taper screw . . . can be removed from holder without losing size.



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of the UNION TWIST DRILL COMPANY

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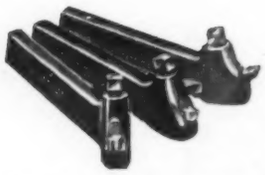
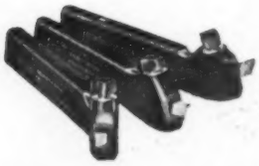
SYSTEM OF TOOL HOLDERS

What speed do you need? 100, 300 or 600 ft. p.m.

Whatever cutting speed is required, whatever the material to be machined, there are correctly designed ARMSTRONG TOOL HOLDERS with bits, blades and cutters of the most efficient cutting material provided by the Armstrong System of Tool Holders.



ARMSTONG TURNING TOOLS for ARMSTRONG HIGH SPEED or other high speed steel cutter-bits



ARMSTRONG CA TOOL HOLDERS for ARMALOY and similar cast-alloy cutter-bits

ARMSTRONG Carbide TOOL HOLDERS for ARMIDE and similar carbide-tipped cutters

Included are: ARMSTRONG TOOL HOLDERS AND CUTTERS	*Recommended Cutter Speed*
ARMSTRONG Turning Tools for ARMSTRONG HIGH SPEED Cutter Bits	50-150 ft. p.m.
ARMSTRONG CA Tool Holders for ARMALOY and similar cast alloy cutters	100-350 ft. p.m.
ARMSTRONG Carbide Tool Holders for ARMIDE and similar carbide-tipped cutters	300-600 ft. p.m.

Write for new Circulars "Armide" and "Armaloy" circulars.

ARMSTRONG BROS. TOOL CO.

"The Tool Holder People"

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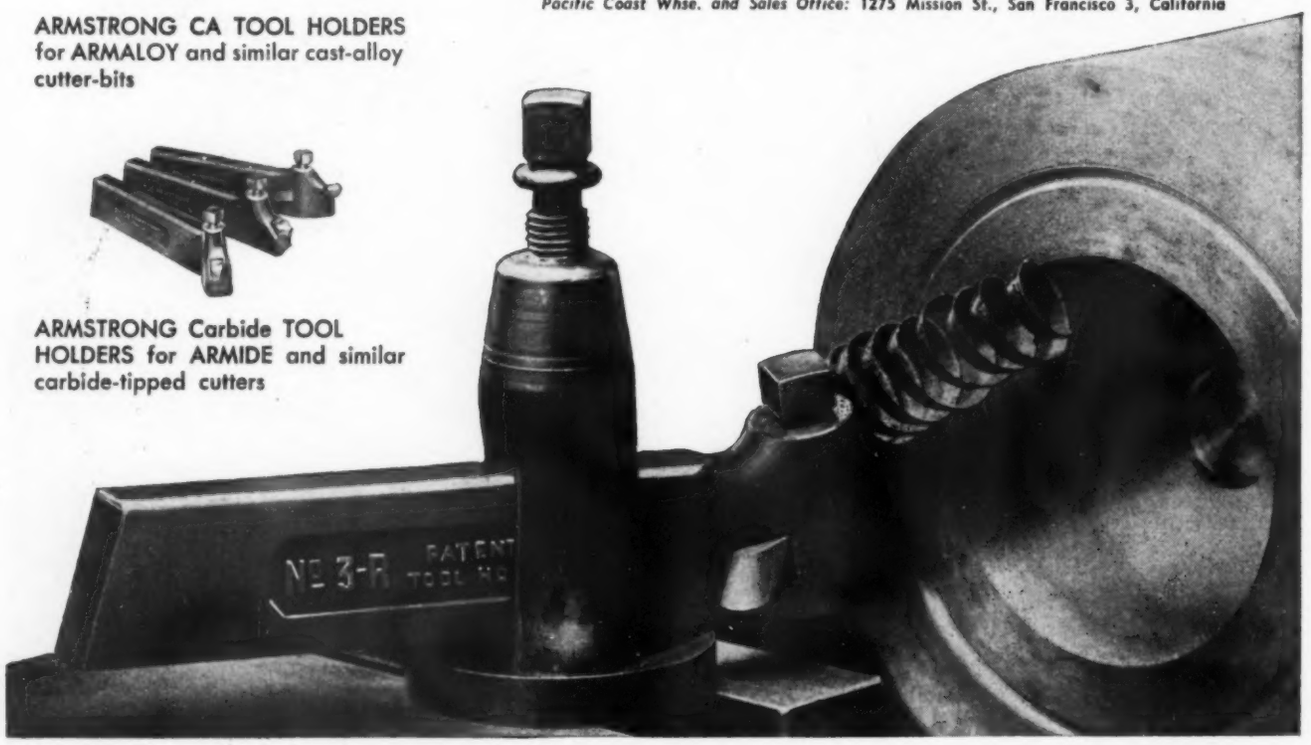
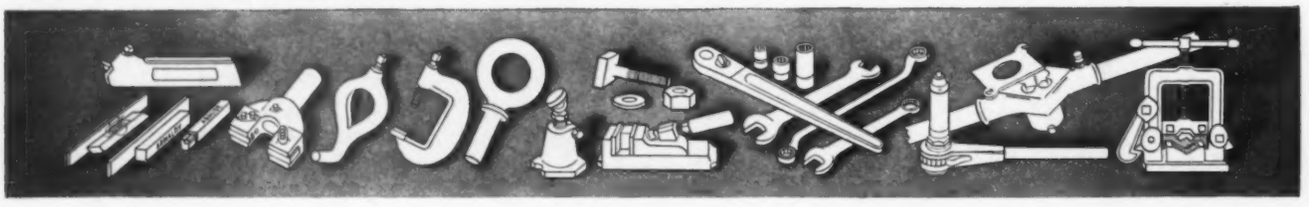




Van Keuren MEASURING WIRES

STANDARD EQUIPMENT *Everywhere*

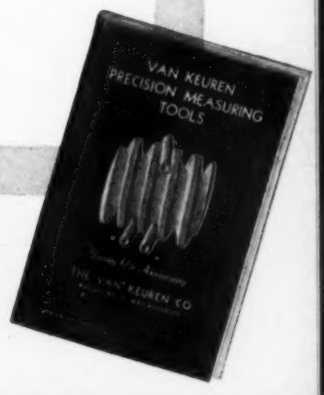
Measuring the pitch diameter of a 1"—8 National Form thread gage with three wires. This method is recommended by the Bureau of Standards.

Van Keuren Measuring Wires are the accepted standard equipment for making pitch diameter measurements of taps, thread gages, precision threaded parts, worms, splines and gears.

Reputable manufacturers of the ground taps and thread gages used for the production and acceptance of threaded holes and nuts use Van Keuren Measuring Wires. You will seldom find them in error if you, too, have Van Keuren Measuring Wires.

Set No. 20 Thread Measuring Wires is a plant necessity for maintaining taps and thread gages within their limits for wear and for proving the pitch diameter of screws and threaded male parts.
Price, High Speed Steel Wires $ 95.00
Price, Carboloy Wires.....$240.00
Special wires from .002" to 1.510" diameter—prices on application.

Set No. 20 Thread Measuring Wires.



It is easy to use Van Keuren wires. The Van Keuren handbook, "Precision Measuring Tools" gives complete tables and simplified formulas for measuring standard and special threads, splines, gears and worms. Send for this valuable 160-page handbook No. 33.

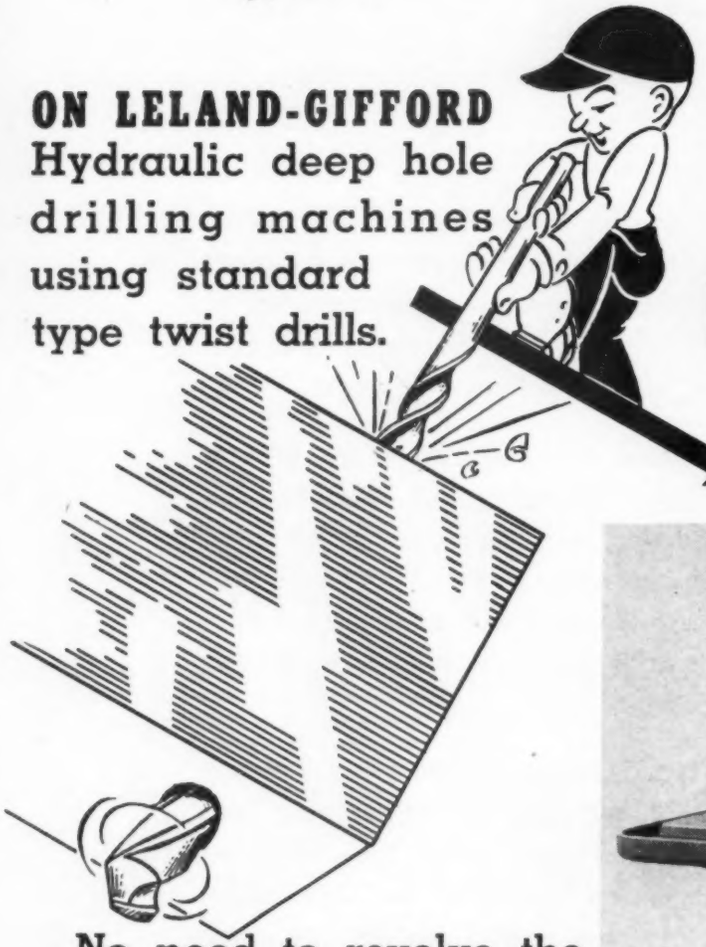
THE Van Keuren CO., 176 WALTHAM STREET, WATERTOWN, MASS.

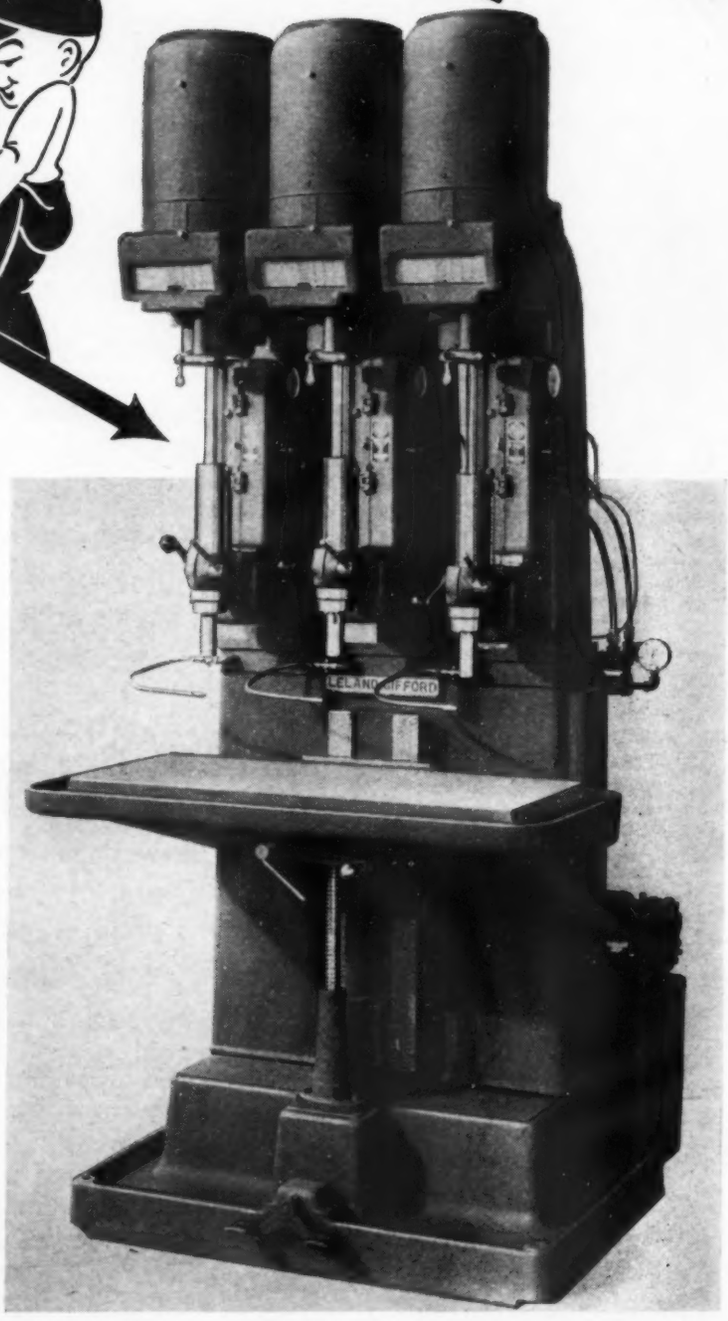
27th YEAR

Light Wave Equipment • Light Wave Micrometers • Gage Blocks • Taper Insert Plug Gages • Wire Type Plug Gages • Measuring Wires • Thread Measuring Wires • Gear Measuring System • Shop Triangles • Carboloy Plug Gages • Carboloy Measuring Wires.

DEEP HOLES ARE DRILLED STRAIGHT and FAST

ON LELAND-GIFFORD
Hydraulic deep hole drilling machines using standard type twist drills.





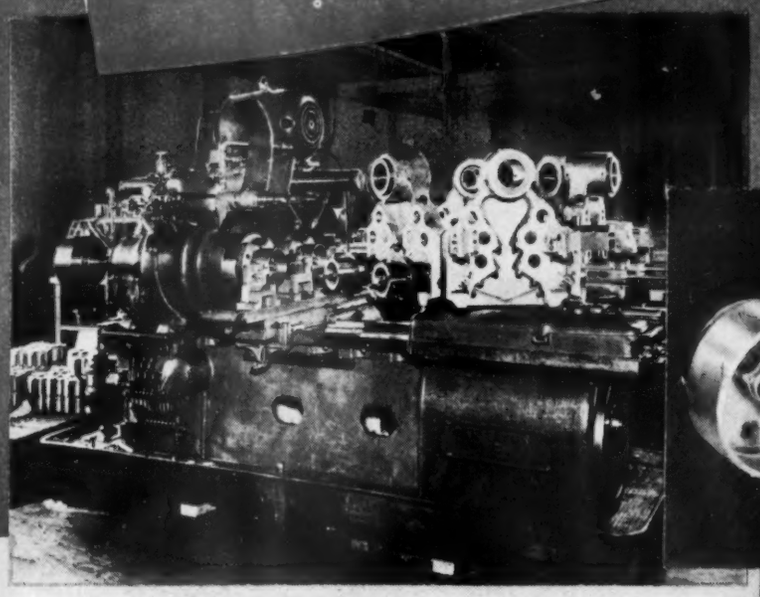
No need to revolve the work which allows simple tooling with conventional type fixtures.

Leland-Gifford engineers will gladly discuss your drilling problems with you.

LELAND GIFFORD
WORCESTER 1, MASSACHUSETTS, U. S. A.

P&J TOOLING ON A 5D2 AUTOMATIC SPEEDS PRODUCTION OF MOTOR HOUSINGS

AVERAGE FLOOR TO FLOOR TIME FOR TWO HOUSINGS: 3.7 MINUTES



DETAILS OF JOB

Part: Motor Housing
Material: Cast Iron
Operation:

1st. T.F.—Loading unit

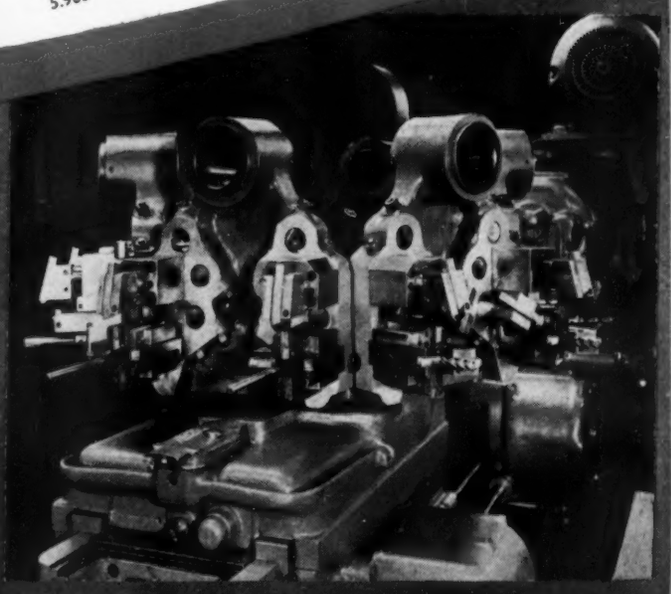
2nd. T.F.—Drill hole 1½" deep; rough turn 1⅛" dia. hub.

3rd. T.F.—Drill hole through

4th. T.F.—Rough bore 5-5/16—5.985" dia.; rough turn O.D.; rough face 1⅛" dia.; core drill hole face at rim.

5th. T.F.—Finish bore .750" dia. hole; chamfer hole; face hub; finish bore 5-5/16"—5.985" dia.; finish turn O.D.; face rim; chamfer corners where necessary.

6th. T.F.—Ream .750" dia. hole; size bore 5.985" dia.; size turn 6.483"—6.502" dia.



Production of duplicate parts on P&J Automatics, quickly and accurately, is exemplified in the job shown and described here. With a floor to floor time of 3.7 minutes for two housings, production is approximately 26.2 pieces per hour from each machine unit, based on an efficiency of 90%.

An important contributing factor to this outstanding production is the tooling made possible by the inherent flexibility of P&J design which permits special tooling to meet the requirements of the job. Another feature is the rigid type of overhead pilot, a P&J design which makes it possible to handle high production work with utmost turret stability and accuracy.

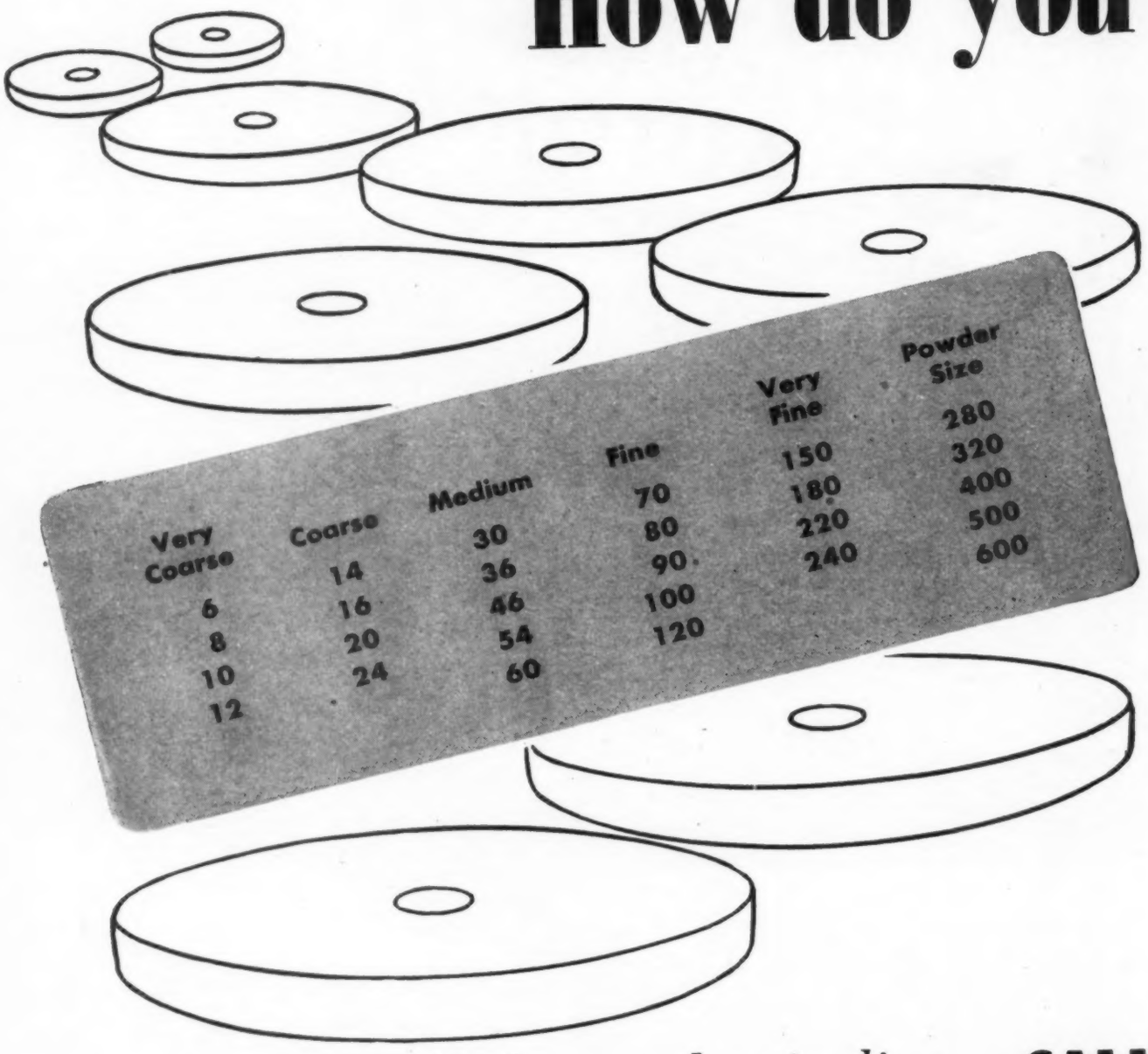
In addition to speed and accuracy, P&J Automatics provide the convenience in operation which conserves man-power and simplifies handling of jobs, simple or difficult.

You can safely place your problems in the hands of P&J engineers for solution.

POTTER & JOHNSTON MACHINE CO.

Pawtucket, R. I.

How do you



A good rule for good grinding... **CALL**

tell which grit to use?

Listed is a commercial classification of standard abrasive grit sizes. They come in a wide range... from 6 classified as very coarse to 600 classified as powder size. And, the variety is further extended by special sizes and combinations. Yet, each one is designed to do a specific job better than any of the rest.

To complicate correct choice even more, there is a long list of variable factors to consider. Among these, you'll find wheel speed, machine condition, specified tolerances, material analysis, related production schedules, and a host of others.

The correct selection hinges on the review which is given to all the controlling factors. Yet... grinding efficiency and economy depend on the right answer.

That's why The Carborundum Company has put together a practical program...a service now deemed essential by many concerns who have been successful in getting improved grinding in terms of better finishes, or at lower cost.

Your nearest contact to this effective service is a CARBORUNDUM representative. You'll find him willing and helpful. Through a sound knowledge of abrasives and first-hand experience of their use and application in the many plants he contacts, he is able to make intelligent recommendations and suggestions. On the more uncommon problems, he can even call on our Abrasive Engineers who are more fully qualified to tackle the tough problems. And, sometimes, the answer comes from the modern laboratories at CARBORUNDUM—where scientists and technicians probe for new information on abrasives, practices and developments.

Here is a sound approach—not only to getting the right grit—but the right combination of grit, bond, grade, structure and all the other parts that make up a grinding wheel. *Plus* knowledge and experience invaluable in modern grinding methods and procedures. It's easy to use. It incurs no obligation. It always makes sense. The Carborundum Company, Niagara Falls, N. Y.

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TRADE | MARK

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WHEELS
- Silicon Carbide
- Aluminum Oxide
- Diamond

Cylinder Hones
Sticks, Stones & Rubs
Specialties

COATED ABRASIVES

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Sheets, Rolls, Discs

ABRASIVE GRAINS AND COMPOUNDS

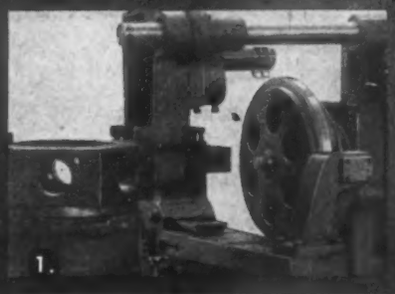
for:
Polishing
Lapping
Pressure Blasting
Finishing

"Carborundum" is a registered trademark which indicates manufacture by The Carborundum Company

ACME Turret Lathe

unexcelled for Low Cost machining of

Gate Valve Parts



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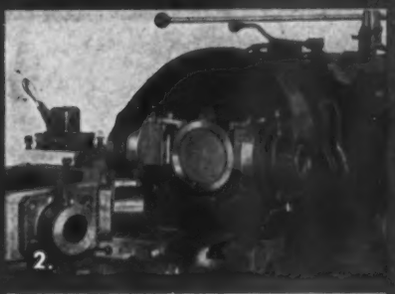

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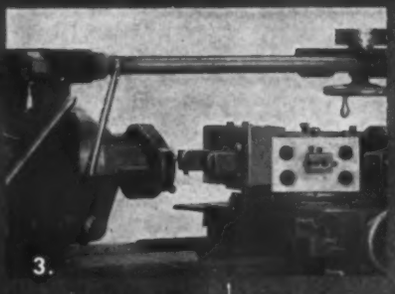


3.

The Cincinnati ACME TURRET LATHE is designed for the complete job.

Complete machining of VALVE STEMS.
Rolling in of VALVE SEAT RINGS.
Machining of VALVE BODIES.
Machining of WEDGES.

1. No. 13-25" FIXED CENTER UNIVERSAL TURRET LATHE—Special tooling for rapid production of VALVE SEAT RINGS. An air controlled holding fixture eliminates possibility of distorted ring when clamping. Adjustable overhead turning heads provide quick means for setting cutters with minimum overhang on various diameter rings.

2. Three position indexing fixture for facing sides—drilling and tapping solid GATE VALVE WEDGES.

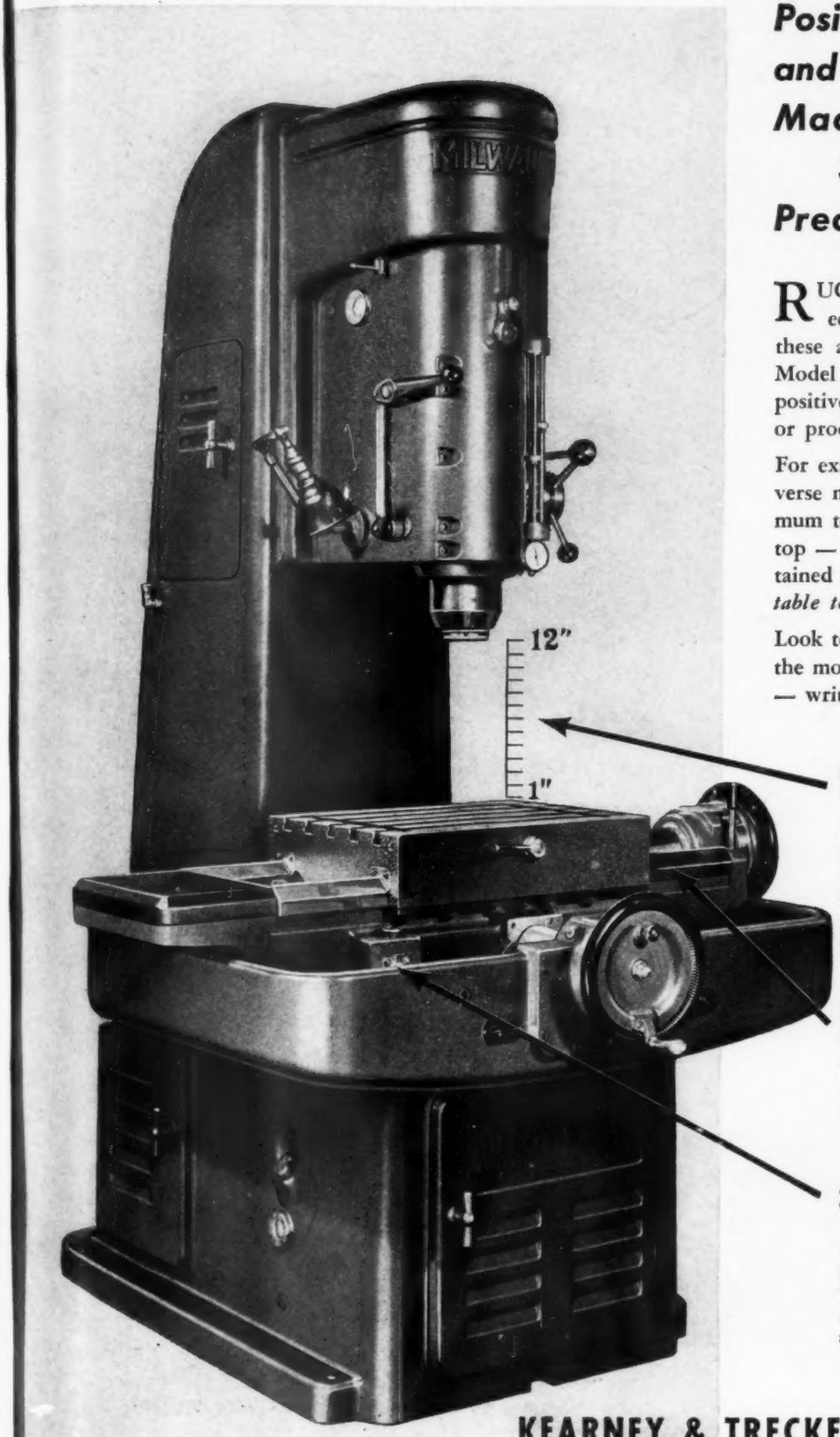
3. Arrangement for rolling in VALVE SEAT RINGS.

Send your problems to our Engineering Dept.

The ACME MACHINE TOOL Co.
CINCINNATI 32, OHIO

When You Do Precision Boring You Can Depend On

THREE DIMENSIONAL ACCURACY!



Positive Alignment of Kearney and Trecker's Autometric Boring Machine Gives You Unerring 3-Way Accuracy for all Precision Boring Operations!

RUGGED CONSTRUCTION . . . precision engineering and design . . . simplicity of operation — these are the basic features of Kearney & Trecker's Model C Autometric Boring Machine which give you positive unsurpassed accuracy for toolroom, laboratory or production precision boring operations!

For example, not only are the longitudinal and transverse movements of the table accurate within a maximum tolerance .0002 inch in any 12 inch at the table top — but this same high degree of accuracy is maintained at all levels up to an elevation 12 inch *above the table top!*

Look to Kearney & Trecker's Model C Autometric for the modern answer to your precision boring problems — write today for catalog No. CMA10.

1. VERTICAL ACCURACY

Base, column and guard cast in one piece to form a solid, rigid foundation and backbone for the entire machine, assure precise alignment at all times. Longitudinal and transverse movements of the table are accurate within a minimum tolerance of .0002 inch in any 12 in. of length at all levels up to 12 in. *above the table top.*

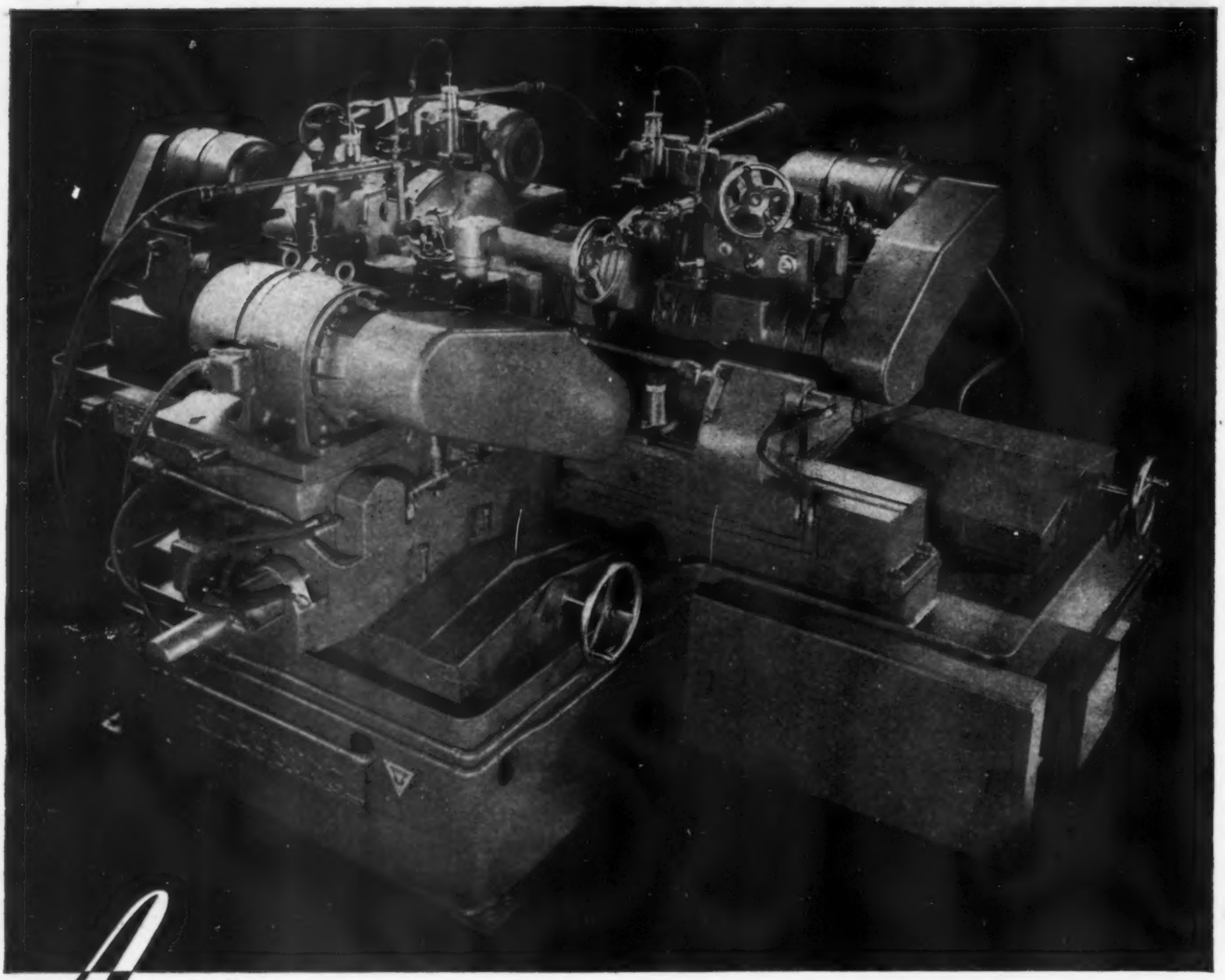
2. LONGITUDINAL ACCURACY

Table is mounted on accurately ground ways and positioned by a precision screw which assures longitudinal accuracy at all work elevations above the table.

3. TRANSVERSE ACCURACY

Saddle is also mounted on accurately ground ways and positioned by a precision screw thus maintaining transverse accuracy at all work elevations. All alignments affecting accuracy of the workpiece are held to within a non-accumulative error of .0002 inch in any 12 inches.

KEARNEY & TRECKER PRODUCTS CORPORATION
MILWAUKEE 14, WISCONSIN



Again THREE HEADS ARE BETTER THAN ONE

. . . Because Fitchburg engineers have combined three standard Bowgage Grinding Heads on a special base to plunge-cut grind three spottings on a 96" torsion spring for tanks. All three dimensions are ground at the same time—and within the time of the longest single grinding operation — and in one handling, with the consequent saving in time and reduced danger of spoilage.

Get the complete facts. The open engineering mind instantly makes a favorable comparison between Fitchburg automatic precision grinding and any other equipment on the market! Install the Fitchburg method now and use your "Head" to cut costs and speed production.

Send your blueprints for our engineers' recommendations. There will be no obligation.

A triple-head Fitchburg Grinder like this may be converted into one double-head grinder and one single-head grinder, or three single grinders. Heads are interchangeable — save your investment.

FITCHBURG GRINDING MACHINE CORP.
FITCHBURG, MASSACHUSETTS, U.S.A.
Manufacturers of — Bowgage Wheelhead Units, Multiple Precision Grinding Units, Saline Grinders, Cylindrical Grinders, Gear Grinders, Both Full Universal Grinders and Special Purpose Grinders

"IT'S GOOD TO BE BACK TO A GISHOLT!"

There's something mighty satisfying in the way these American machine tools go about their work. They don't fool. They mean business!

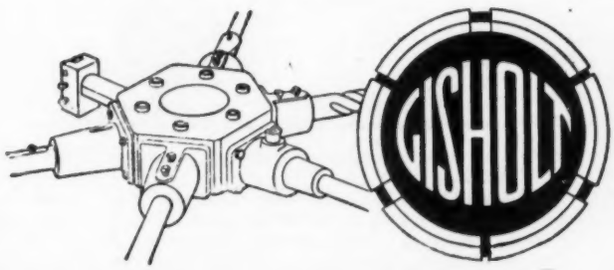
They meant business when the war started. The Axis boys found it out. Right to the bitter end.

And they mean business now! Another kind of business. The kind that lets a fellow produce more, earn more, get a bigger kick out of life. That's what our men fought for. And it's great to be back again.

GISHOLT MACHINE COMPANY

1201 East Washington Avenue • Madison 3, Wisconsin

Note to Ex-G.I.: We've proved a few things, too, here at Gisholt in the past few years. And we're putting them to work in the form of new refinements that mean greater speed, greater accuracy, easier operation. You'll find them in the new Gisholts you'll come back to.



Look Ahead . . . Keep Ahead . . . With Gisholt Improvements in Metal Turning

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

This 12,500% increase *sounds fantastic!*

But True!

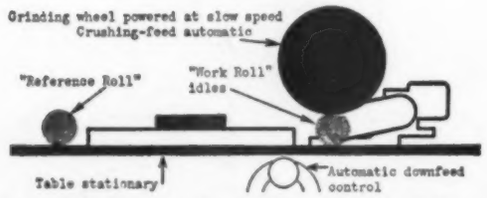
One of the major drawbacks to crush form grinding precision flat form contours has been the inability to produce on a practical production basis. This obstacle has been eliminated in two ways by the new Thompson Truforming Process.

First: Truform Grinders are engineered and built as a single unit, eliminating the failures of make-shift crushing arrangements and attachments.

Second: TWO CRUSHING ROLLS ARE USED. This is a major advancement, because it greatly extends crushing roll life and makes possible, for the first time, quantity production without constantly disturbing the set-up to re-process the crushing roll.

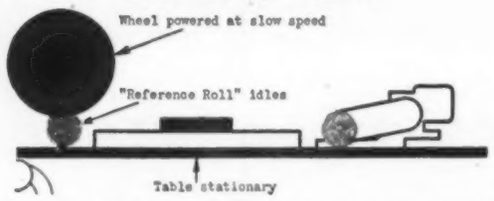
How two rolls operate in the Truforming Process is briefly illustrated and described below. The normal crushing or truing position is shown first.

Normal Crushing Position
Also Truing or Dressing



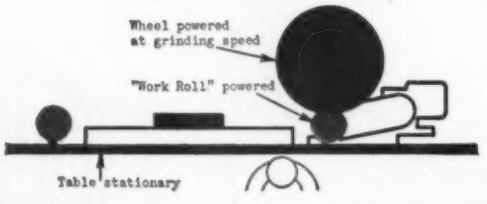
This is the position for the initial crushing of the wheel—and for subsequent truing or dressings when production grinding. On an eight pitch modified buttress thread form, 125 dressings were provided by the "work roll" before losing form.

Touching-up Position



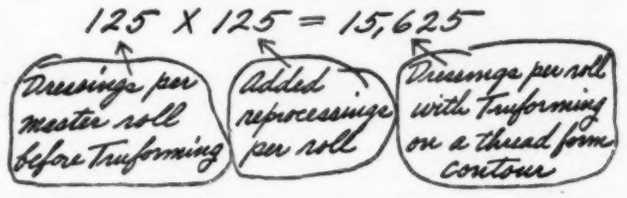
When the "work roll" loses form the table is moved to bring the grinding wheel over the "reference roll" for touching up, as shown above.

Re-processing Position



Because both rolls are table mounted, are in perfect alignment, and can be brought in the same relation to the grinding wheel, the original degree of accuracy can be quickly transferred from the "reference roll" back into the grinding wheel . . . and then ground back into the "work roll" as shown above.

The machine is then ready for production grinding again without disturbing the set-up or removing anything from the machine. In this way the "work roll" can be re-processed whenever it loses form and can be used for hundreds of additional dressings, or until it is worn out. Duplicate crushing rolls can be ground in the same way on all Thompson Truform Grinders.

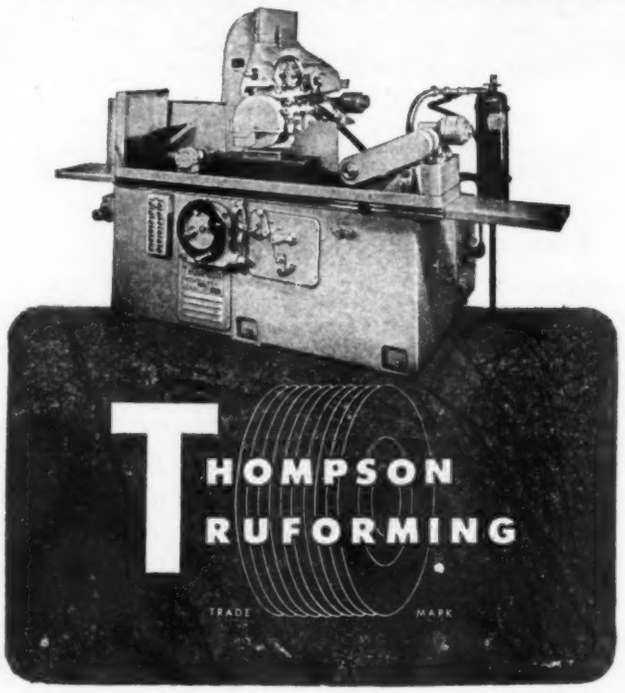

125 X 125 = 15,625
Dressings per master roll before Truforming
Added reprocessings per roll
Dressings per roll with Truforming on a thread form contour

What this means in savings is illustrated by the following example, involving a modified buttress thread form with an eight pitch form. Where two rolls are used in the Thompson Truform Process, it was possible to get *over 15,625 dressings* from the "work roll" before it was worn out. This meant an increase in continuous production (without changing or disturbing set-up) of 12,500%.

Write for the new 8-page Truform Leaflet—"Why didn't you tell me about this process before?"

Address Dept. 16

The Thompson Grinder Company • Springfield, Ohio



Bliss' Stamping Grounds

HERE COME THOSE NEW GENERAL ELECTRIC REFRIGERATORS. Photo at G.E.'s Erie plant shows stamping of doors in a 350-ton Bliss two-point, enclosed mechanical press.

WHEN YOU SAY that the kitchen is the nucleus of "domestic Bliss," you show you know your presses. For wherever you look, your eyes hit on pressed metal objects produced on large and small Bliss equipment.

Let's make a quick tour. There's the stove, sink, dish-washer, cabinet and table tops, handles, cutlery, pails, cooking utensils.* And, of course, the refrigerator, vacuum cleaner, and electric mixer—not to mention the clock, towel-rack and shelves.

And before we turn off the light on this subject, let's take note of the switch, the fittings of the fluorescent bulbs, the housing and line fittings in the walls, the laminations of the transformers and the generating equipment at the powerhouse.

We call it "Bliss Stamping Grounds" because Bliss builds presses small enough and large enough to blank, form or draw all these triumphs of the modern kitchen and more. We have been at it since 1857 and our engineers have amassed a fund of pressed-metal "know-how" unavailable anywhere else. It's at your disposal when you call on Bliss.

**And speaking of food, those fruit and vegetable cans in the closet were probably made on Bliss automatic can machinery.*

E. W. BLISS COMPANY, DETROIT 2, MICHIGAN

WORKS AT: Brooklyn; Toledo, Cleveland, Salem, Ohio; Hastings, Mich.; Derby, England; Paris, France • SALES OFFICES: Detroit; Brooklyn; Cleveland, Dayton, Toledo, Ohio; Lansing, Mich.; Chicago; Philadelphia; Rochester; New Haven; Boston; Toronto.

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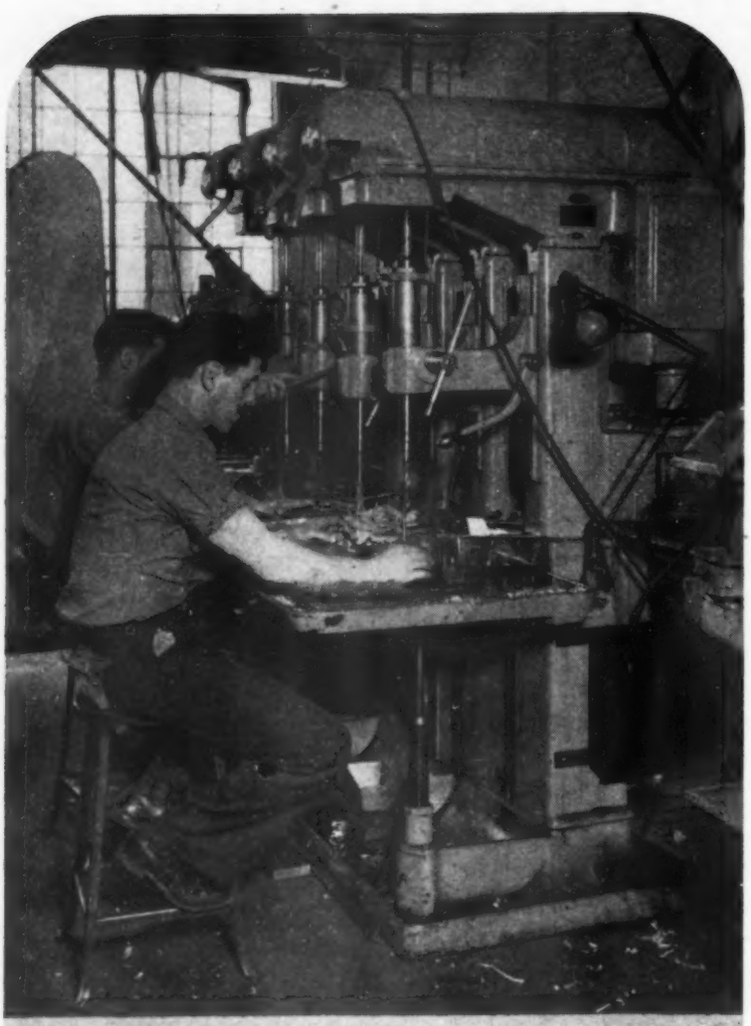
BLISS BUILDS MORE TYPES AND SIZES OF PRESSES THAN ANY OTHER COMPANY



Handles Drilling and Reaming Operations Faster

FOSDICK

High Speed DRILL

● When you have work requiring holes up to 1¼" diameter you will get them faster within prescribed tolerances on a Fosdick High Speed Drill.

Here's a high speed machine for drilling — reaming — counterboring —and tapping operations that is turning out accurate work at low cost in hundreds of plants.

For example the four spindle machine shown is drilling and reaming holes of various diameters in aircraft parts. The work moves in jigs from one spindle to another and several operations are completed before work is removed from jig.

The unusually wide range of speeds available—the ease with which they are changed—the simplicity of operation makes this sturdy drill popular for small hole drilling.

Furnished in single or multiple spindles up to six with center distances ranging from 12 inches up to 36 inches.

Complete information on various combinations are contained in the Fosdick High Speed Drill Bulletin H. S. A. Available upon request — write for yours.

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CINCINNATI 23, ··· OHIO

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- by the *"tap-capsule"*—each ground thread tap in its individual transparent plastic tube
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by their *superior performance*—cold-tempering at 120° below zero makes them stronger yet less brittle, assures better threads and more of them per tap, on plastics and abrasive materials as well as on steels, cast iron and alloys.

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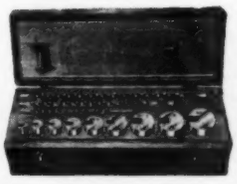
Threadwell offers an ideal Arbor Press for the purpose that is light, strong and inexpensive. Write for descriptive Bulletin.



Threadwell SINCE 1902
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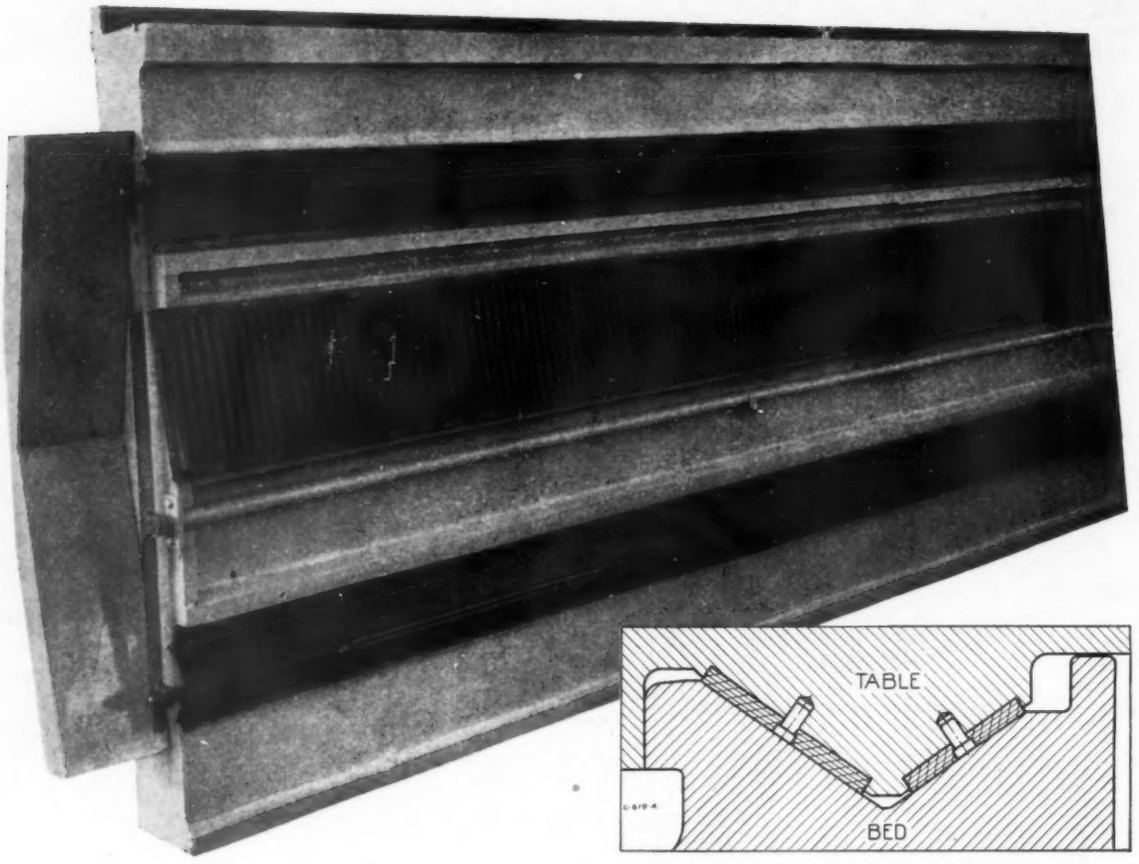

Announcing... the GRAY NON-METALLIC TABLE WAY

An epoch-making development in the Metal Working Industry. Cutting, scoring and undue wear of ways has been the "bug bear" of shop men for years. These troubles are now practically eliminated by the new Gray Non-Metallic Table Way (Patented and Patent Pending). The bearing surfaces of the ways of the table are laminated plastic plates secured to the table by laminated plastic pins.

Exhaustive tests and the experience of many users have shown that laminated plastic has remarkably low friction, consequently, wear is negligible; and, as it has no welding properties, the danger of cutting and scoring is reduced to a minimum.

Due to the negligible friction of the plastic plate, and the fact that it is a heat insulator, practically no heat is transmitted from the way surfaces to the metal table. This makes it possible to run the table at any feasible speed without danger of the table curling up due to the heat generated at the bearing surfaces.

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SWITCH PLANERS
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MILLING PLANERS
•
PLANER TYPE MILLING MACHINES
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HORIZONTAL BORING MACHINES

"A Planer is no better than its ways."
There is no adequate substitute for the Gray Non-Metallic Table Way.

The G.A. GRAY Co.

CINCINNATI 7, OHIO, U.S.A.

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"With **Gulf Electro Cutting Oil** we get more production per tool grind"

says this Foreman

Actual photo of a Machine Shop Foreman (right) consulting with a Gulf Lubrication Service Engineer on results with Gulf Electro Cutting Oil in machining various parts on automatic screw machines.

"When we switched to Gulf Electro Cutting Oil, we noted an immediate improvement in the overall efficiency of our automatics," says this Foreman. "We credit this oil particularly for a big increase in production per tool grind—it helps keep our tools sharp."

Gulf quality cutting oils can give you a vital advantage in machining efficiency that may help you make substantial cuts in unit production costs. Here's the important reason: Every Gulf cutting oil has specific properties which insure better performance on certain types of jobs!

It will pay you to get the complete story of the advantages of Gulf cutting oils. Call in a Gulf Lubrication Service Engineer today and let him show you how they can help you improve your machining practice. Write, wire, or phone your nearest Gulf office.

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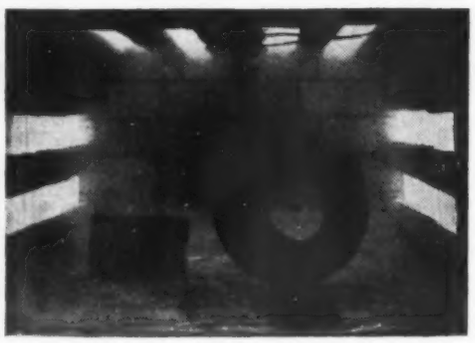
1 EASY LOW TEMPERATURE HEAT TREATMENT



• *Easy Low Temperature Heat Treatment*—At last tool makers have in VEGA a LOW TEMPERATURE air-hardening tool steel that is amazingly easy to heat treat. VEGA's lower hardening temperature (1550° F) eliminates the need for pack hardening. And because VEGA can be heat treated from a temperature 200° F lower than the 5% chromium air-hardening steels, it reduces the tendency to scale, makes special high temperature furnaces unnecessary. These advantages, when put to work on your heat treating jobs, will point the way to lower tool-making costs.

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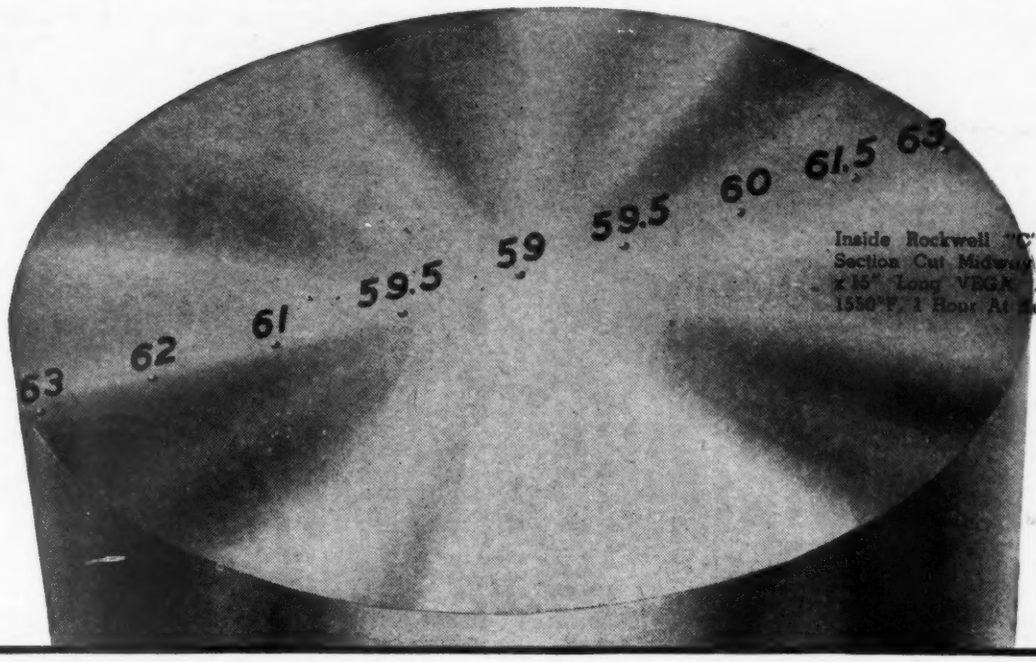
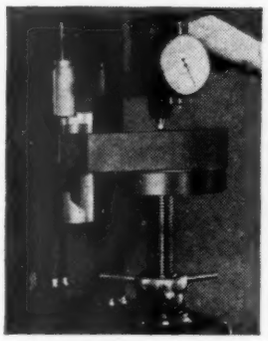
Branches at: Buffalo, Chicago, Cincinnati, Cleveland, Dayton, Detroit, Hartford, Indianapolis, New York, Philadelphia, Providence, St. Louis.



Inside Rockwell "C" Hardness Of Section Cut Midway On 8" Round x 15" Long VEGA Air Cooled At 1550°F. 1 Hour At Heat.

2 UNIFORM HARDENING IN VERY HEAVY SECTIONS



• *Uniform Hardening In Very Heavy Sections*—By combining the deep-hardening characteristics of air-hardening steels with the simplicity of low temperature heat treatment, VEGA can save you many costly hours spent in heat treating. Notice the uniformity of Rockwell hardness values from surface to center of this 8" VEGA round. Let VEGA prove its versatility on many of your jobs such as blanking, piercing, trimming and forming sheet metal in light and heavy gauges—jobs where minimum distortion and size change and uniform hardening in very heavy sections are required.

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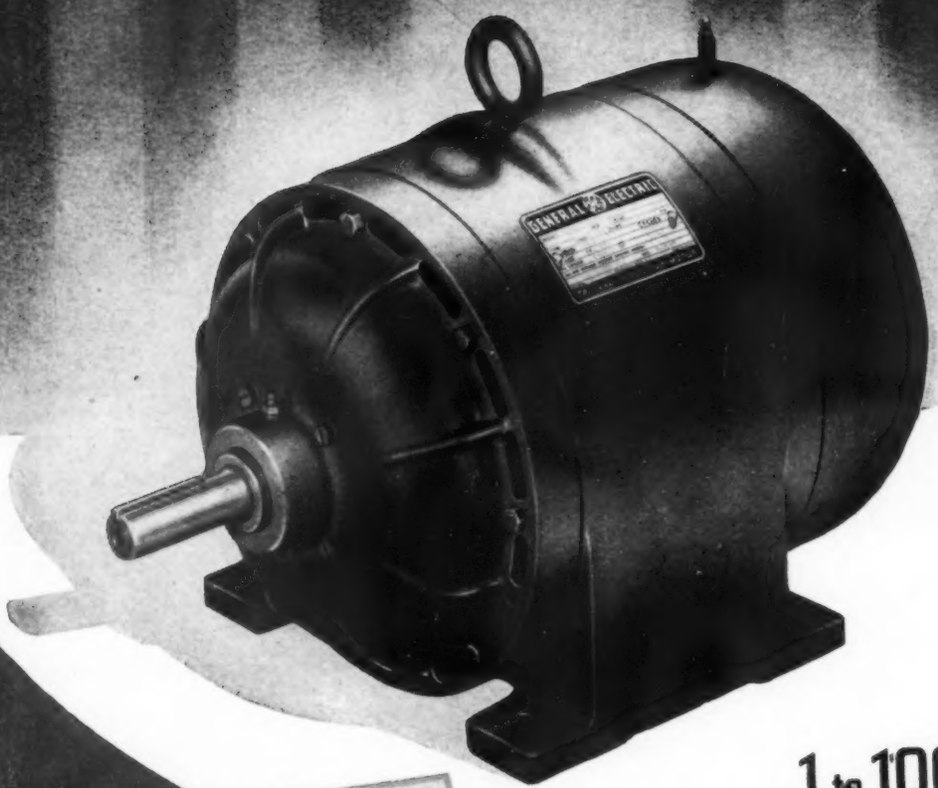
GENERAL ELECTRIC Announces:



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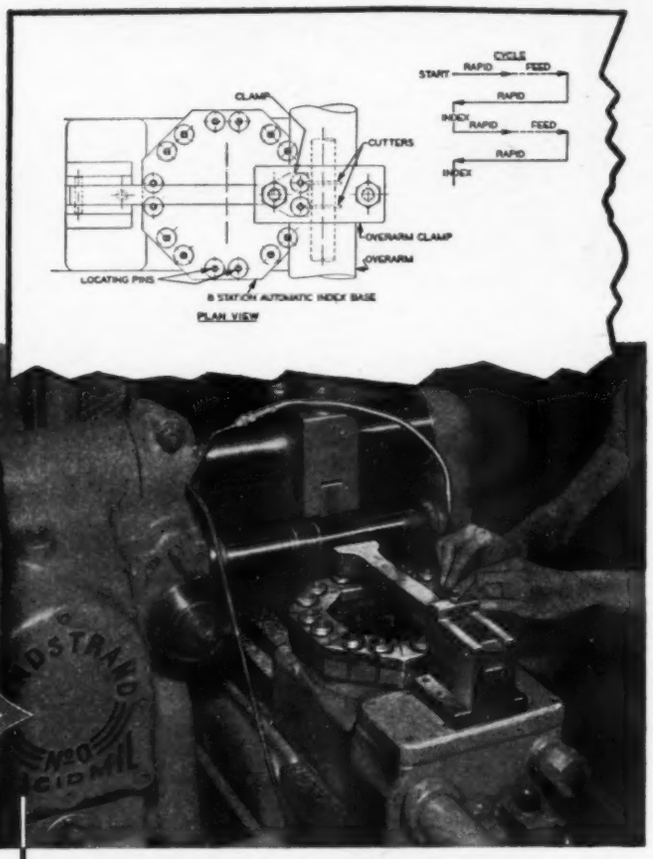
We believe that these are industry's most dependable motors. They are designed specifically for use in many adverse atmospheres—in iron dust, outdoors, in hazardous areas, and chemical atmospheres. Their scope of application is as wide as the field of industrial motor use. Safeguarded against most sources of motor damage, their longer life and lower maintenance will make them economical motors for use on almost every job. *General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

TRI/CLAD MOTORS

HOW TO *improve* MILLING METHODS *with* . . .

SUNDSTRAND "ENGINEERED" PRODUCTION



1 STANDARD RIGIDMILS WITH FIXTURES AND TOOLING TO SUIT YOUR WORK

Milling slots in small brass fuse parts on a standard Sundstrand No. 0 Rigidmil. Machine is equipped with a Sundstrand standard automatic index base which makes it possible to produce 800 fuse parts per hour.

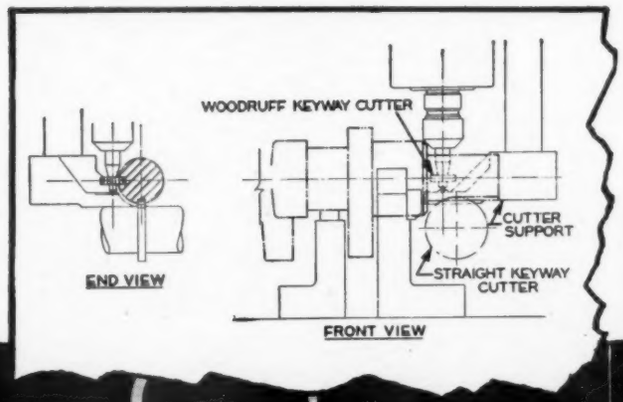
The Sundstrand automatic index base is often used to increase production, improve accuracy and eliminate manual indexing. In addition to increasing production on small parts, its design permits heavy cuts without disturbing accuracy and increases production through eliminating loading time.

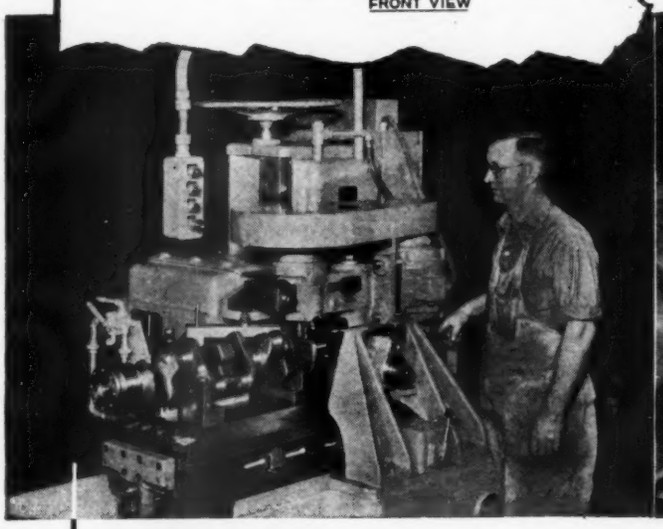
THERE are two basic approaches to solving milling production problems: (1) obtaining standard machines, then trying to process parts over these machines as economically as possible, (2) designing the most profitable processing method, then obtaining machines to suit this method—standard or semi-standard machines if possible, or entirely special machines, if necessary.

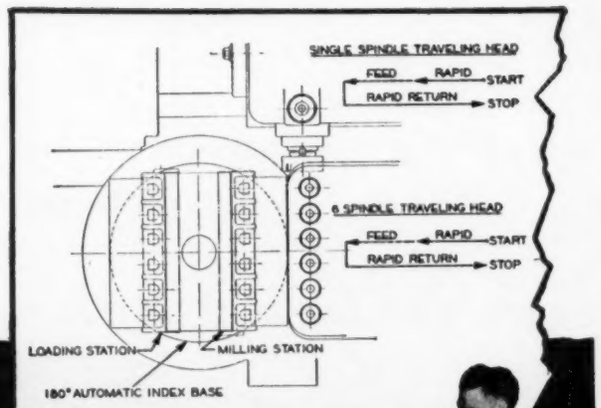
This latter method is Sundstrand "Engineered Production" . . . a most practical approach to economical milling. Here's how it has been applied in three different plants on three different milling problems.

SUNDSTRAND MACHINE TOOL CO. ROCKFORD, ILLINOIS, U.S.A.

RIGIDMILS | FLUID-SCREW RIGIDMILS | AUTOMATIC LATHES | HYDRAULIC EQUIPMENT







2 RIGIDMILS WITH SPECIAL HEADS AND TOOLING

Simultaneous milling of one Woodruff keyway and one straight keyway in end of crankshaft. Machine is a Sundstrand standard model 22 Rigidmil with standard horizontal spindle head for milling straight keyway and an attached pivoting head for milling the Woodruff keyway. Milling both keyways simultaneously increases production. Further, keyways are held in definite relation to each other by milling in same setting of crankshaft.

3 ENTIRELY SPECIAL MACHINES

Special Sundstrand machine mills 6 angular spark plug seats and faces end of cylinder head. One six spindle traveling head machines the seats while a horizontal spindle head machines the end. A two station fixture is mounted on a 180° automatic index base. Operator loads and unloads in one station while another part is being machined in other station. Clamping and unclamping is hydraulically actuated.

Free

More proof of the successful application of Sundstrand "Engineered" milling production is contained in this book. Over 60 problem solutions complete with machining diagrams are included. Write for your copy today. Ask for bulletin No. 148.

SUNDSTRAND MACHINE TOOL COMPANY

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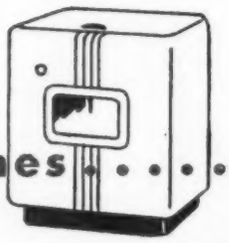
DRILLING AND CENTERING MACHINES | SPECIAL MILLING AND TURNING MACHINES

washing machines . . . . planes . . . . .



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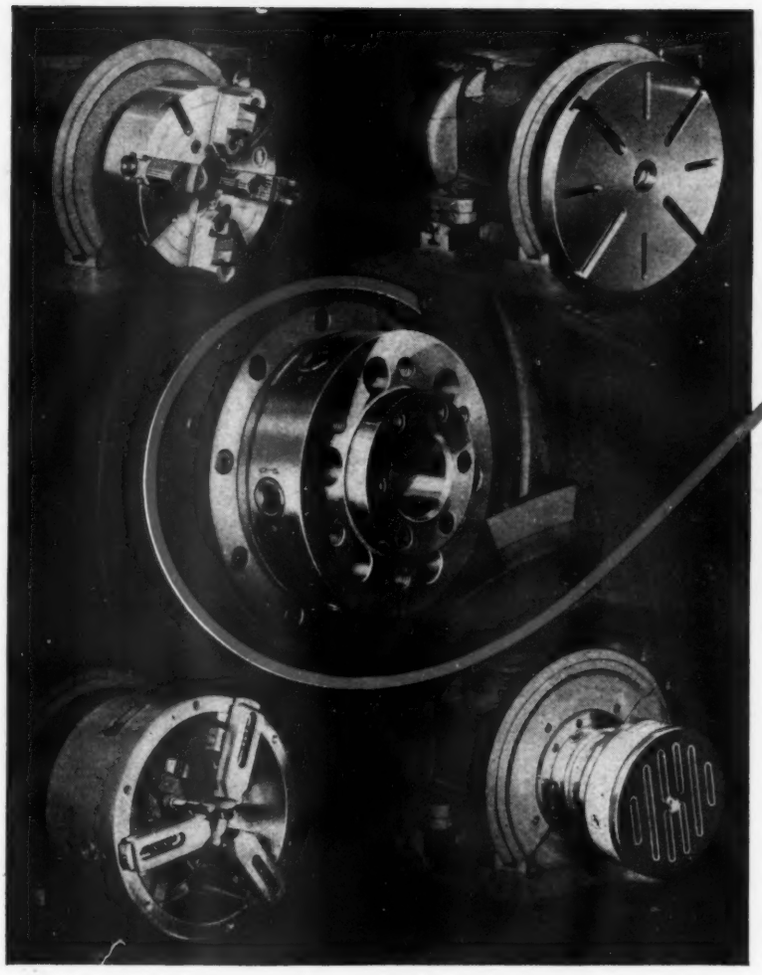
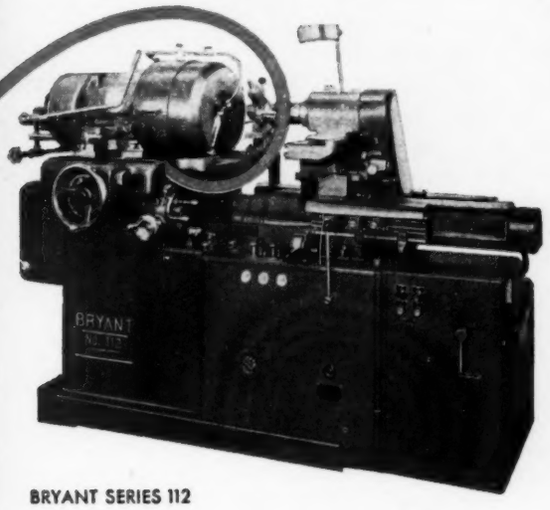




BRYANT SERIES 112

CAM LOCK

FOR INTERNAL GRINDING

● **MINIMIZES SETUP TIME ON TOOL ROOM WORK**

Holding fixture changes in less than 2 minutes? . . . You can on the Bryant Series 112 Hydraulic Internal Grinder. This modern tool room grinder is equipped with an American Standard Spindle Nose with the quick-change cam lock feature. This means that (a) Accurate centering is provided by the tapered pilot on the spindle nose fitting into a tapered recess in the back of the chuck, (b) Squareness of mounting is obtained by the ground face in the back of the chuck registering against the ground face of the spindle nose, (c) The chuck is held rigidly in position by the locking cams in the spindle nose which engage the cam locking studs in the back of the chuck, and (d) The cam lock feature also provides a quick means of mounting and unmounting the chuck. A clockwise, one-quarter turn of the wrench on each locking cam is sufficient to lock the chuck securely.

You will find important tool room features like this at every point of the Bryant Series 112 machines. It all adds up to less down time, more accurate work, finer work finish and fast production.

For complete details — Send for the Man from Bryant.

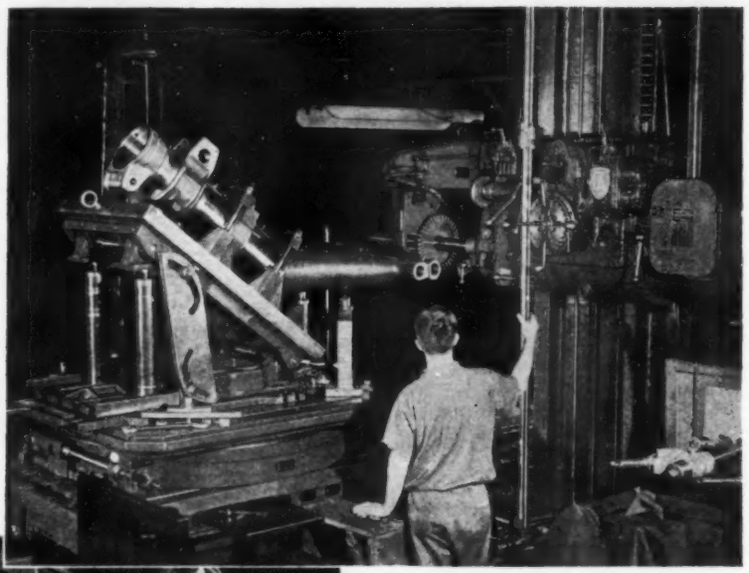
Write for big new catalog which describes this machine in detail

BRYANT

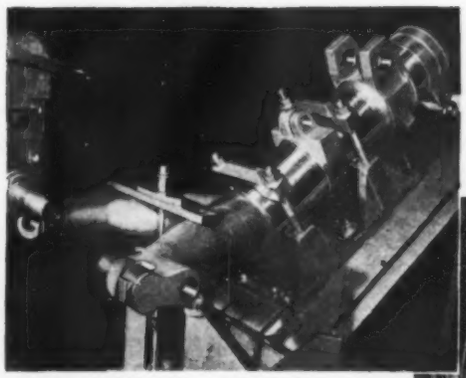
BRYANT CHUCKING GRINDER CO.

SPRINGFIELD, VERMONT, U. S. A.

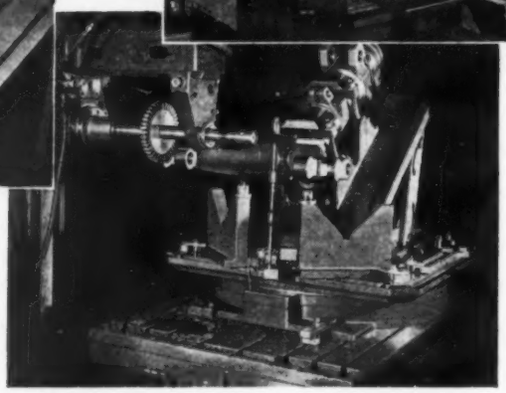
THERE'S ALWAYS A *Common Sense* WAY TO EFFICIENTLY HANDLE WORK LIKE THIS *on a* G. & L.



A combination of standard attachments is used on this Giddings & Lewis table type machine to simplify the setup and machining of an Aerol landing gear cylinder.

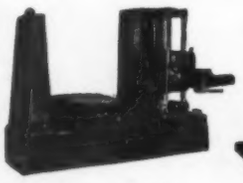


Aerol landing gear cylinder. Its awkward shape requires ingenuity in setting-up for precision machining operations.

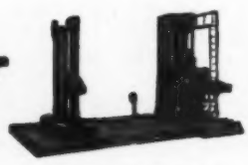


Conventional side milling operation being performed on a G. & L. horizontal boring machine equipped with an overarm type arbor support.

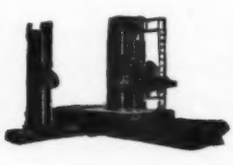
Photographs through the courtesy of the Cleveland Pneumatic Tool Company, Cleveland, Ohio



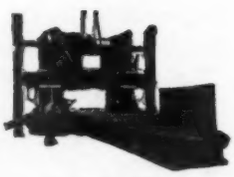
G. & L. Table Type Machine



G. & L. Floor Type Machine



G. & L. Planer Type Machine



G. & L. Multiple Head Type Machine

GIDDINGS & LEWIS MACHINE TOOL CO.

IT IS *Common Sense* TO:

1. Use a simple holding fixture on unusual shaped parts.
2. Mill, drill and bore in a single work setting.
3. Index work on a rotary table for correct alignment.
4. Use standard machines with helpful attachments for difficult operations.
5. Use a Giddings & Lewis machine on irregular parts similar to this aircraft landing gear cylinder.

There is always a practical and common sense way to set up odd-shaped work and perform difficult machining operations on a Giddings & Lewis machine. These graphic illustrations show how an awkward-to-handle aircraft landing gear cylinder is setup and machined on a standard G. & L. equipped with standard attachments. Few other machines have the open working range, capacity and flexibility required to mount this work and then perform precision boring, drilling and milling operations. Trunnions, trunnion lugs, drag brace lugs and lock lugs are machined before the part is removed from its holding fixture.

Attachments Reduce Machining Time and Eliminate Excessive Handling

Three standard G. & L. attachments are used to cut machining time and reduce set-ups on this part. They are:

(1) Combination plain and hand feed rotary table that indexes the work with micrometer accuracy and on which the holding fixture is mounted.

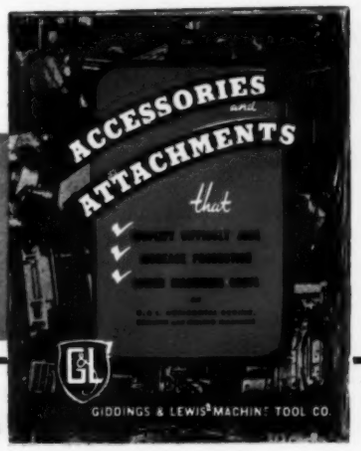
(2) An overarm arbor support attachment is used to permit milling the slots in the trunnion lugs. The part does not have to be routed to a conventional milling machine when this attachment is used.

(3) An angular milling attachment (not shown) mills the flats on the trunnion lugs and drills and bores at right angles to the machine spindle. The work remains in its fixture for these operations. This combination of helpful attachments increases the working range and adds to the flexibility of the Giddings & Lewis horizontal boring machine.

When you are confronted with the problem of machining work of unusual size or shape, it is advantageous to consider standard G. & L. equipment for your needs. Experienced Giddings & Lewis engineers will gladly point out ways and means of reducing costs on special as well as general run work.

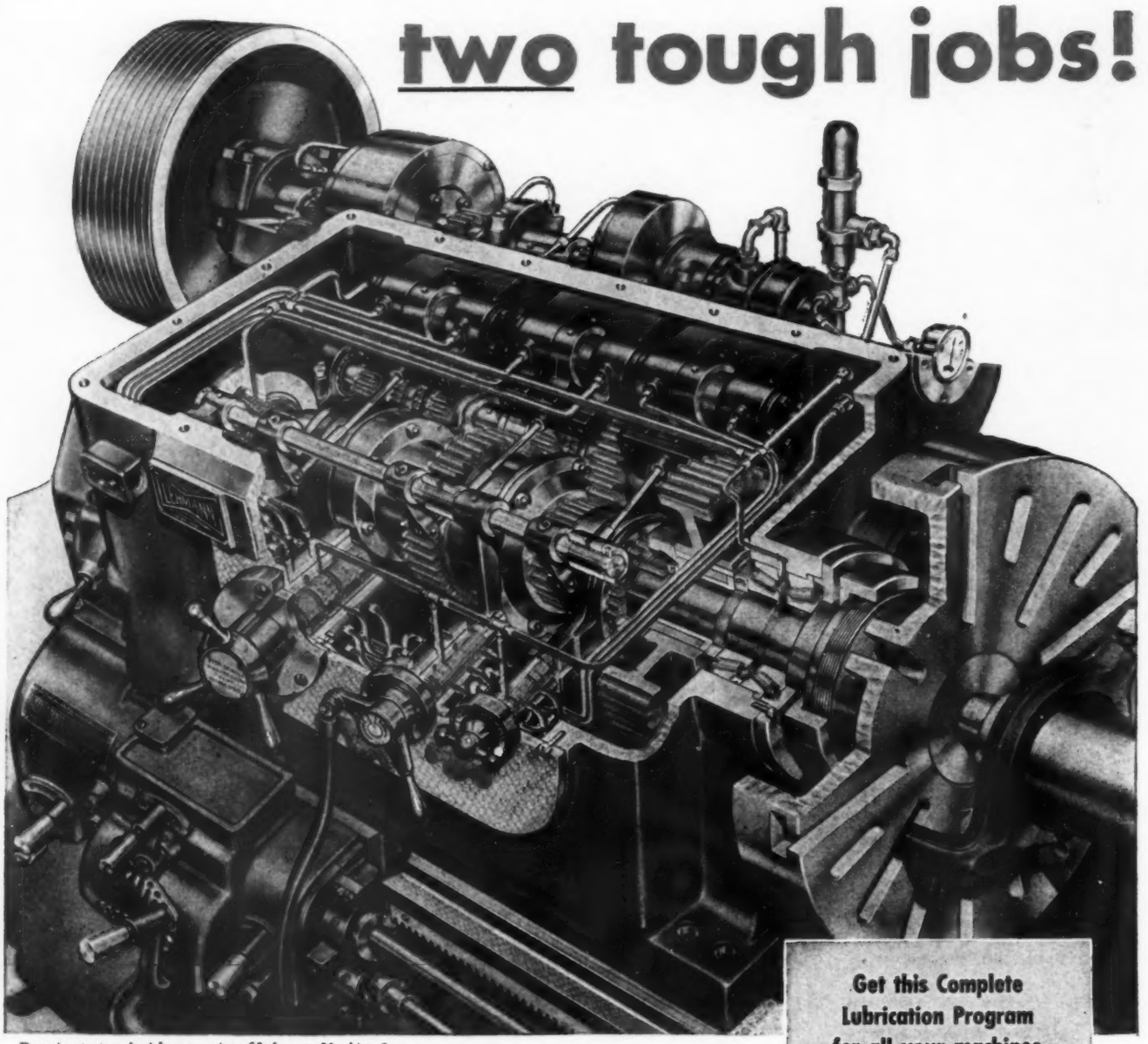
NEW 48-PAGE BOOK *Free*

Description of G. & L. accessories and attachments written especially for men interested in increasing production. Write now for your copy—ask for Catalog A. M. 56.



138 Doty Street • Fond du Lac, Wis.

Here one oil does two tough jobs!



Drawing prepared with cooperation of Lehmann Machine Co.

THIS ingenious variable-speed lathe poses a double problem for oil. For the same oil serves as both a hydraulic medium for the sensitive controls and as a lubricant for all headstock gears and bearings.

Both of these jobs require an oil with high chemical stability. Inside the hydraulic system, the oil must resist formation of deposits that clog lines, valves and clutch and brake mechanisms. On the gears and bearings it must fight off oxidation, due to continuous splashing and churning in the presence of air. Also, it must maintain strong films to minimize wear.

Many machine tool manufacturers now recommend Gargoyle Vacuoline Oil because of its high stability in double-duty service of this nature. It helps maintain the accuracy of the machine and reduces wear over long periods of continuous service. Ask your Socony-Vacuum Representative for facts.

Get this Complete Lubrication Program for all your machines

- Lubrication Study of Your Entire Plant
- Recommendations to Improve Lubrication
- Lubrication Schedules and Controls
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Socony-Vacuum Oil Co., Inc.

and Affiliates: Magnolia Petroleum Co. • General Petroleum Corporation

TUNE IN "INFORMATION PLEASE"—MONDAY EVENINGS, 9:30 E.D.T.—N.B.C.

A production record like this is a challenge to any plant that turns out precision parts in large quantities.

Here is a steel Bearing Race, $3\frac{1}{4} \times 4\frac{5}{8}$", turned from SAE 4620 Tubing. Close concentricity must be held between outside contour and the bored and reamed inside diameter.

An Acme-Gridley $4\frac{3}{4}$" Four Spindle Bar Automatic does the complete job in less than $1\frac{1}{2}$ minutes machine time.

We suggest you compare that with the time it would take to do this job on equipment you now have. More important, if you want a modern-method time estimate on producing a special job of your own, write us about it.

Modern-method time saving is certainly one of the answers to your price competition and larger volume of sales.

The NATIONAL ACME CO.

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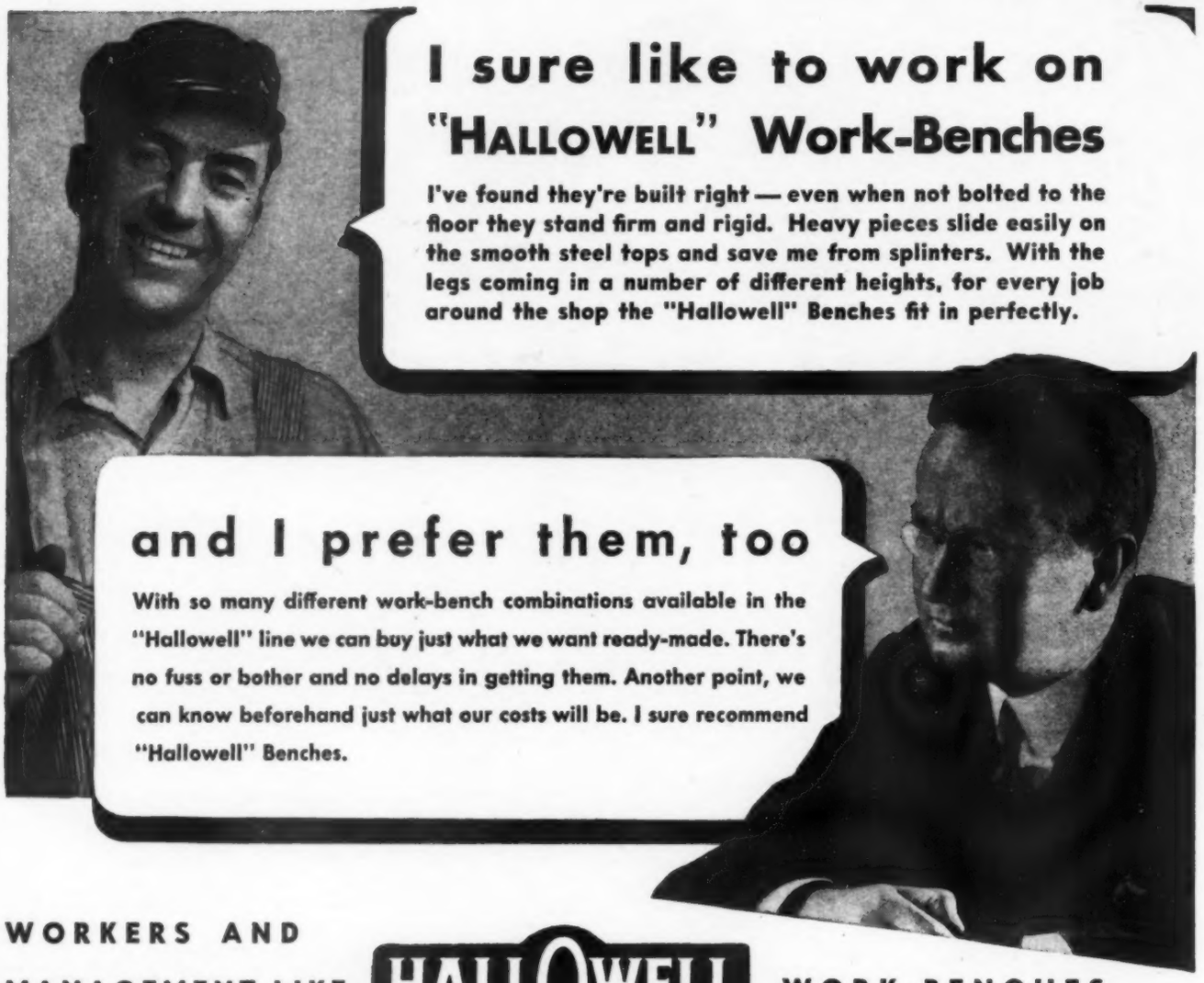
Acme-Gridley Bar and Chucking Automatics: 1-4-6 and 8 Spindle • Hydraulic Thread Rolling Machines • Automatic Threading Dies and Taps • The Chronolog-Limit, Motor Starter and Control Station Switches • Solenoids Centrifuges • Contract Manufacturing



I sure like to work on "HALLOWELL" Work-Benches

I've found they're built right — even when not bolted to the floor they stand firm and rigid. Heavy pieces slide easily on the smooth steel tops and save me from splinters. With the legs coming in a number of different heights, for every job around the shop the "Hallowell" Benches fit in perfectly.

and I prefer them, too

With so many different work-bench combinations available in the "Hallowell" line we can buy just what we want ready-made. There's no fuss or bother and no delays in getting them. Another point, we can know beforehand just what our costs will be. I sure recommend "Hallowell" Benches.

WORKERS AND MANAGEMENT LIKE HALLOWELL WORK-BENCHES

You'll find the same opinion in every shop or factory where "Hallowell" work-benches of steel are used. "It's tops", "Makes working a pleasure" . . . that's what they say all the way from the shop to the front office. And no wonder! For these benches are sturdy enough to withstand years of hard usage, steady enough so that they don't require costly bolting to the floor, and are available in over *1300 ready-made*, interchangeable combinations. You're always sure of getting just what you want with "Hallowell"!

Write for the free "Hallowell" Catalog, today. **"Unbrako" and "Hallowell" products are sold entirely through distributors.**

Fig. 732
Pat'd & Pats. Pend.
Drawer is extra

OVER 43 YEARS IN BUSINESS

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA., BOX 4

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Largest Stocks in History Assure

PROMPT SHIPMENT OF ALCOA ALUMINUM SCREW MACHINE STOCK

Standard Sizes • 11S-T3 and 17S-T • ROUNDS • HEXAGONS

Don't let lack of stock hold up your screw machine production. Decide now to "turn it out of Alcoa Aluminum", and get prompt shipment on all the stock you need. Stocks of Alcoa Aluminum are again available in principal cities.

Hundreds of manufacturers of screw machine products have switched to Alcoa Aluminum. It cuts their costs and swells their profits—prices are less than pre-war. They have discovered that it can be worked at top machine speeds; that it results in a fine finish, highly resistant to corrosion; and—gives three times as many pieces per pound as other screw machine stocks.

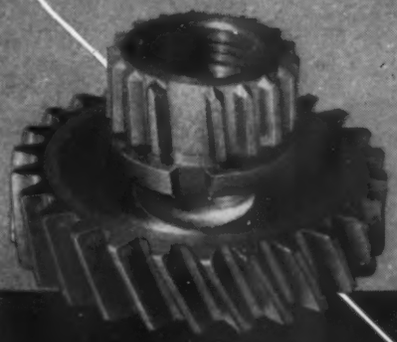
Back of the nationwide stocks stand larger supplies at Alcoa mills. So—when you switch to Alcoa Aluminum Screw Machine Stock, you can be sure of a steady source of supply. Phone the nearby Alcoa office. ALUMINUM COMPANY OF AMERICA, 2107 Gulf Building, Pittsburgh 19, Pennsylvania.

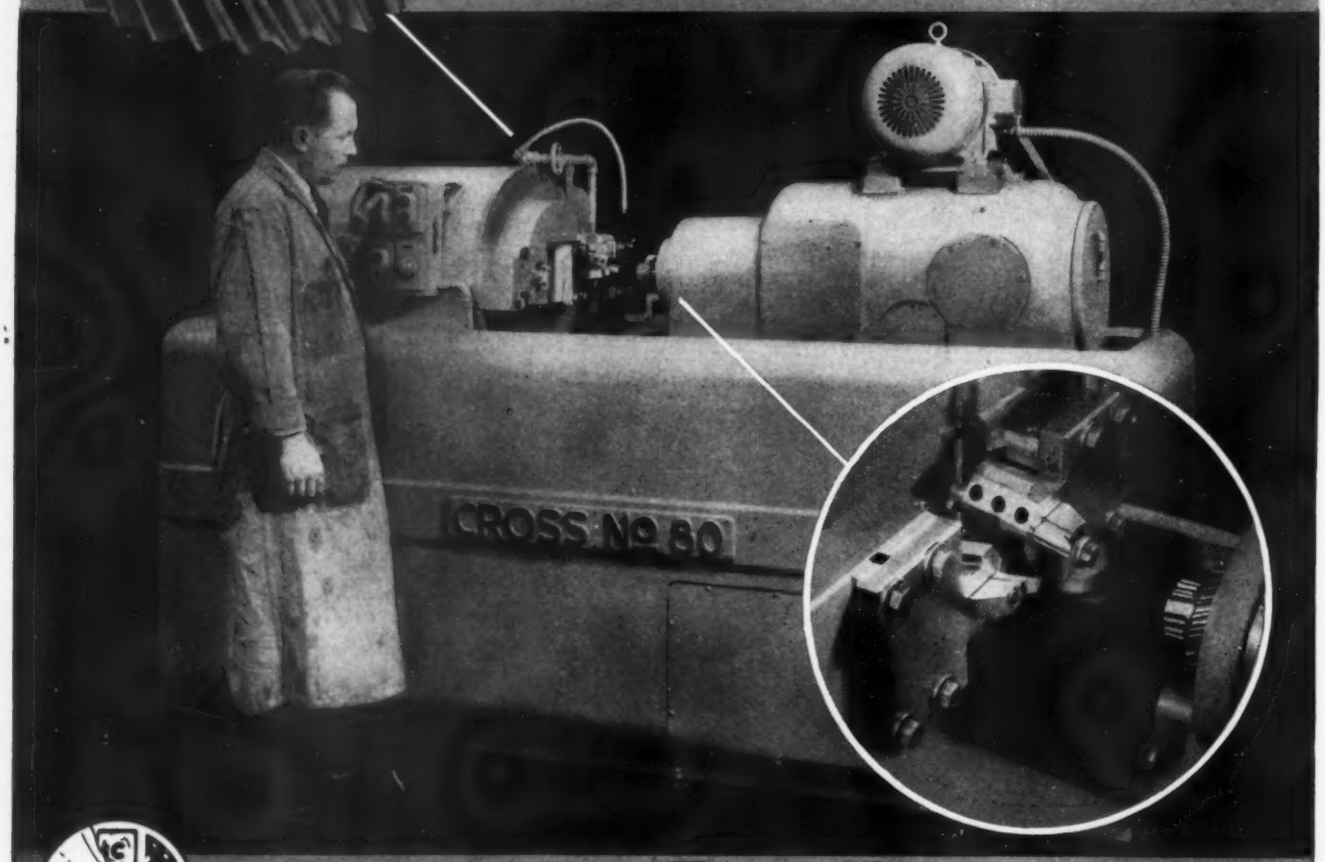
ALCOA ALUMINUM

GEAR SHAPER *Extraordinary*

Two tools simultaneously cut two helical slots in transmission gears . . . In a full automatic cycle controlled by push button, the operator loads a part on the arbor and presses a button. The workhead quick-traverses to the tools, where the ram starts its reciprocating helical action as the tools on each side feed in to depth. When the slots are completed, the tool slides withdraw, reciprocation stops and the workhead returns to the loading position . . .

This machine is only one example of Cross engineering that multiplies operator out-put. By producing more, the unit cost is cut and profit is assured, even in today's market of dwindling and uncertain profits. Investigate the possibilities of applying the Cross principle to *your* production. Write, sending prints and details, to The Cross Company, Detroit 7, Mich., Dept. 233. And be sure to ask about the new Cross motion picture "Tools For Profit," available now for group showings.





MACHINE TOOLS

CROSS

ESTABLISHED 1898

SPECIAL MACHINES

TURNING · MILLING · DRILLING · BORING · REAMING · TAPPING · GRINDING

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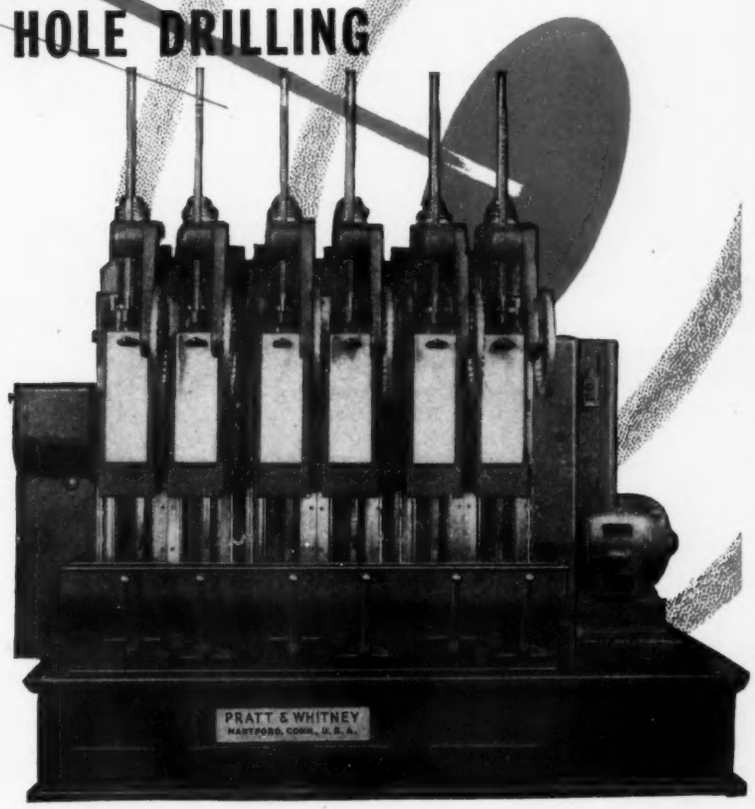
STRAIGHT AND *TRUE*....

. . . FOR HIGH-PRODUCTION PRECISION DEEP HOLE DRILLING



The Pratt & Whitney Multiple Spindle Vertical Deep Hole Driller performs a variety of high-production precision drilling jobs with speed and accuracy. It can handle drilling operations on a wide diversity of products from rifle and pistol barrels, sewing machine components, connecting rods, and boiler stay-bolts to aircraft engine valves.

The standard vertical driller has a drilling range diameter from 3/16″ to 5/8″; a maximum drilling length of 12″; nominal spindle speeds of 900–3000 rpm.; and nominal feeds from 3/4″ to 2″ per minute . . . plus many built-in features including controlled high-pressure coolant; force-feed lubrication; automatic power knock-off and return of the work slides at the completion of the drilling.

Flexible . . . adaptable . . . easily operated. The vertical driller is geared to modern mass-production requirements.

Write for further information or phone your nearest Pratt & Whitney Branch Office.

PRATT & WHITNEY

Division Niles-Bement-Pond Company

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"Put it on the Blanchard"

Here is another example of how the BLANCHARD increases the production of these sprocket shaft supports over the former method.

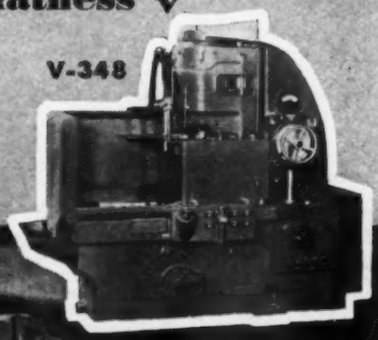
These steel forged sprocket shaft supports are ground on a No. 18 Blanchard Surface Grinder equipped with a 36" chuck. Four pieces are placed on the chuck at one time and 1/8" to 3/16" of metal is removed from each surface.

They are ground at the rate of 10 per hour, whereas only 2½ pieces were produced per hour by the former method of production.

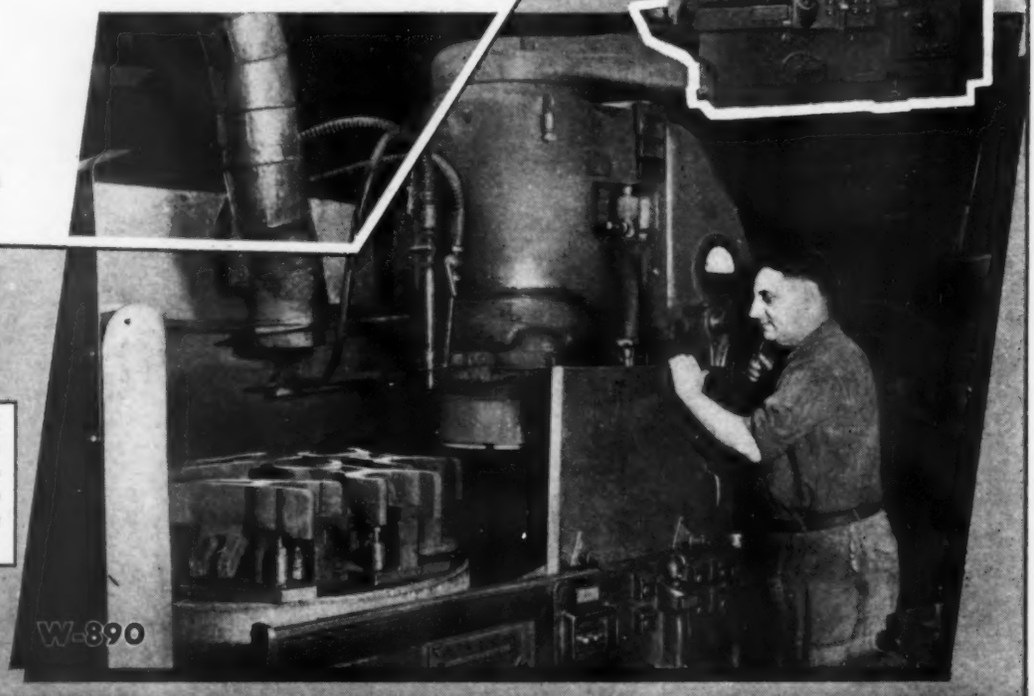
When surfaces must be flat and parallel, "put it on the Blanchard" and increase production.

GET THESE ADVANTAGES

- Production ✓
- Adaptability ✓
- Fixture Saving
- Operation Saving
- Material Saving
- Close Limits
- Fine Finish
- Flatness ✓



Send for your free copy of "Work Done on the Blanchard", third edition. This new book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.



BLANCHARD

The BLANCHARD MACHINE COMPANY

64 STATE STREET, CAMBRIDGE 39, MASS., U. S. A.

VANADIUM TYPE G

Chisels . . . Rivet Sets . . . Pipe Cutters . . . Gripper and Heading Dies . . . Punches . . . Track Tools . . . Precision Gears for Aerial Photographic Cameras . . . Fire-arm Parts . . . Spindles and Shafts.

VANADIUM TYPE D

Spindles and Shafts . . . Arbors . . . Springs . . . Pins . . . High Tensile Bolts and Rods . . . Drop Forge Dies . . . Pressure Chambers . . . Wrenches . . . Feed Screws . . . Gears . . . Machine Tool Parts.

VANADIUM TYPE H

Copper Forging Dies . . . Embossing Dies . . . Key Striking Dies . . . Collets . . . Shear Blades . . . Heavy Duty Seaming Rolls . . . Swaging Dies . . . Punches . . . Woodworking Knives.

Type Tool Steels

VANADIUM TYPE K

Jewelers' Striking Dies . . . Shear Knives . . . Forming Dies . . . Cold Heading Dies . . . Punches . . . Surgical Instruments . . . Plunger Molds.

VANADIUM TYPE BB

Bearing Races . . . Bearing Rolls . . . Plug Gauges . . . Special Arbors . . . Precision Gauges . . . Special Rolls for Fine Flat Ware . . . Seaming Rolls for Steel Drums . . . Pivot and Fine Ball Bearings . . . Cold Rolls.

VANADIUM TYPE N

Paper Knives . . . Knurls . . . Cams . . . Bearing Scrapers . . . Cutlery . . . Fine Edged Tools . . . Drills . . . Broaches, etc.

All of the above steels are available in billets, bars, cold drawn shapes, solid forgings, sheet, plate, circles, and drill rod.

VANADIUM-ALLOYS STEEL COMPANY

First Quality Tool Steels

Latrobe, Pennsylvania

COLONIAL STEEL DIVISION . . . ANCHOR DRAWN STEEL CO.

SNYDER SPECIAL CENTER DRIVE MACHINE FOR DOUBLE END TURNING OF SHAFTS

Newest development of a well-proven special-purpose machine design is this center drive, double end turning machine with front and rear tool slides.

Work part shown is an automotive axle shaft on which production is 90 to 100 cycles an hour at 80% efficiency, using tungsten carbide tools throughout. Any similar type shaft can be processed on this type machine with comparable efficiency.

Tailstock center is retractable to permit easy manual loading and is brought in hydraulically by a manually operated hydraulic valve. The part is held between centers without deflection and is gripped by three serrated jaws in the center drive. After loading, the center drive is manually engaged through a clutch lever on the headstock and the part is rotated.

On starting the work cycle, front tools move into position and travel along the work, turning various diameters and forming a taper on one end while the rear tools likewise move in and perform facing, chamfering and undercutting operations.

When turning is completed to limits ready for heat treating and finish grinding, tools retract from the work and then return to starting position, thus avoiding spiral tool marks on the work.

Four motors provide operating power, one for headstock and rotation of work, two for hydraulic equipment, one for the coolant pump. Base is welded steel and houses coolant trough and chip pan.

This versatile unit can be adapted to a wide range of related turning applications and offers opportunities for notable economies in production costs. We invite your inquiries. *Snyder Tool & Engineering Company, 3400 E. Lafayette Ave., Detroit 7, Michigan.*

21 Years of Successful Cooperation with Leading American Industries

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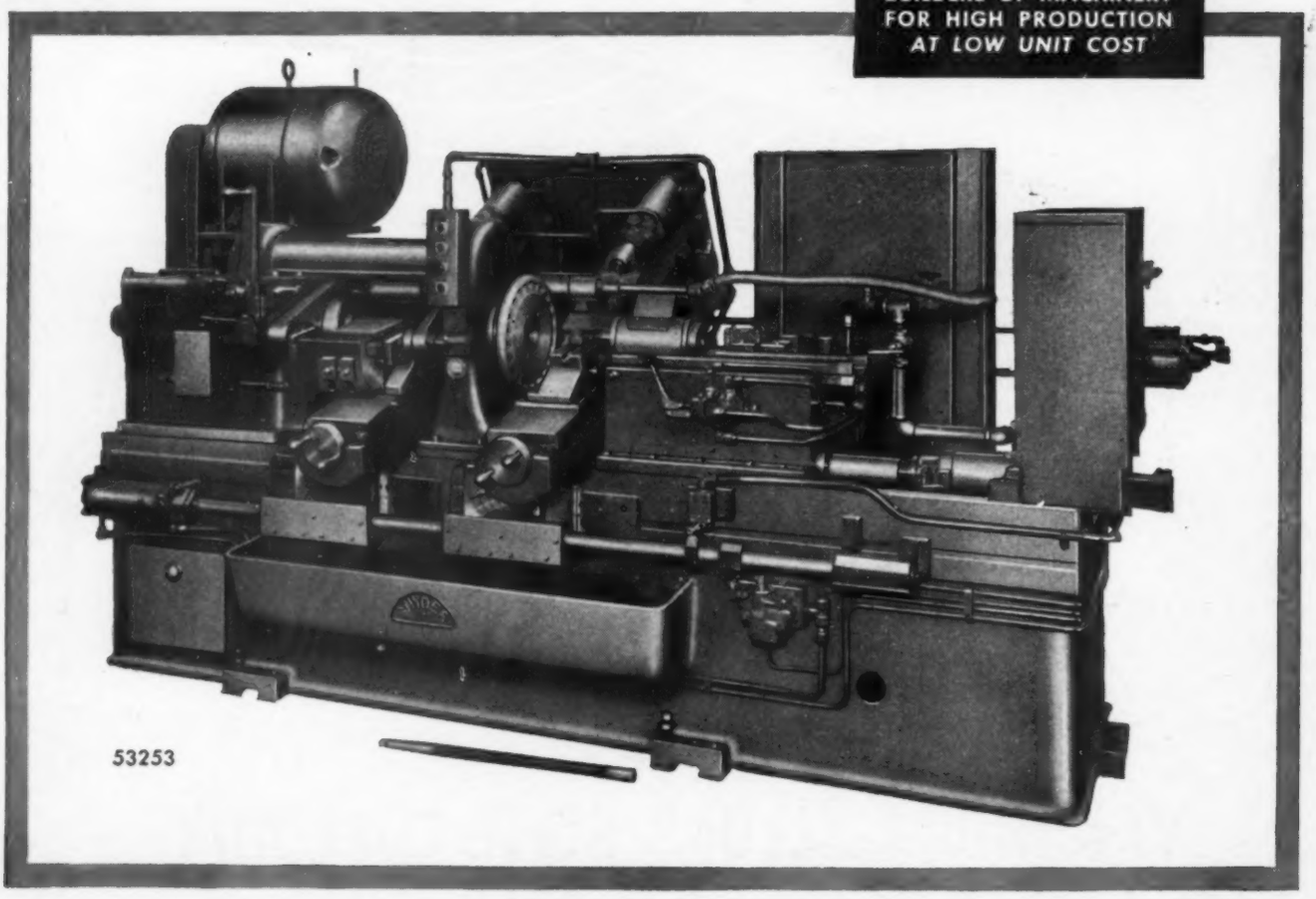
DESIGNERS AND BUILDERS OF MACHINERY FOR HIGH PRODUCTION AT LOW UNIT COST



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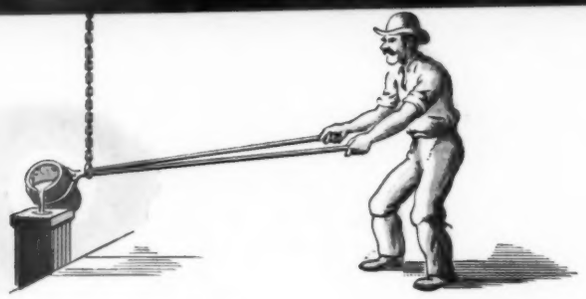

Brass-making has been our business for more than 100 YEARS

Yes, we've seen a lot of changes in the brass industry in our century and more of experience, and not the least of them was in the casting of the metal . . . from the small, manually handled, coal-fired crucibles of not too long ago, to the present electric induction furnaces skillfully manipulated through overhead hoists and pouring tons of metal in copper-lined, water-cooled molds.

Producing copper, brass, bronze, nickel silver and other copper base metals that will fully and economically meet your manufacturing requirements and the service standards of your product is the result of a far-reaching program of planned research and the step by step metallurgical control of both metals and methods—from "mine to consumer."

Today The American Brass Company is Industry's most coordinated and largest supplier of copper and copper alloys in the form of sheet, wire, rods, tubes and other shapes. Its facilities for serving you are outlined on the following page.

THE AMERICAN BRASS COMPANY
***General Offices:* Waterbury 88, Connecticut**

SERVING INDUSTRY'S NEEDS FOR

Copper, Brass & Bronze

10 MANUFACTURING PLANTS

5 WAREHOUSES

27 OFFICES AND AGENCIES

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ST. LOUIS 2, MISSOURI	408 Pine Street
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WASHINGTON 5, D. C.	1511 K Street, N. W.
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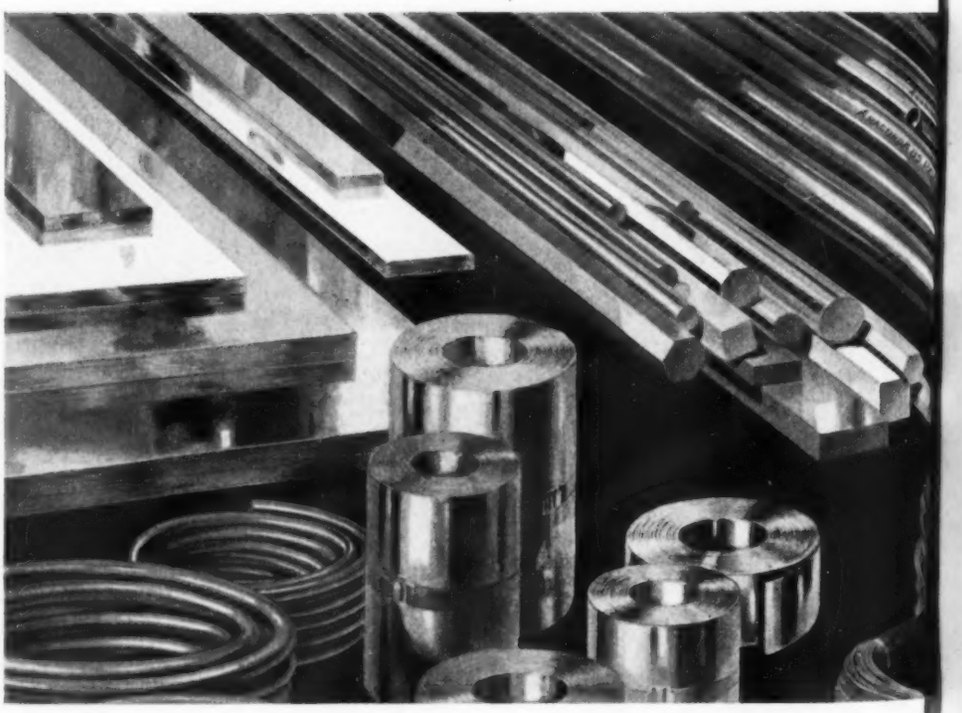
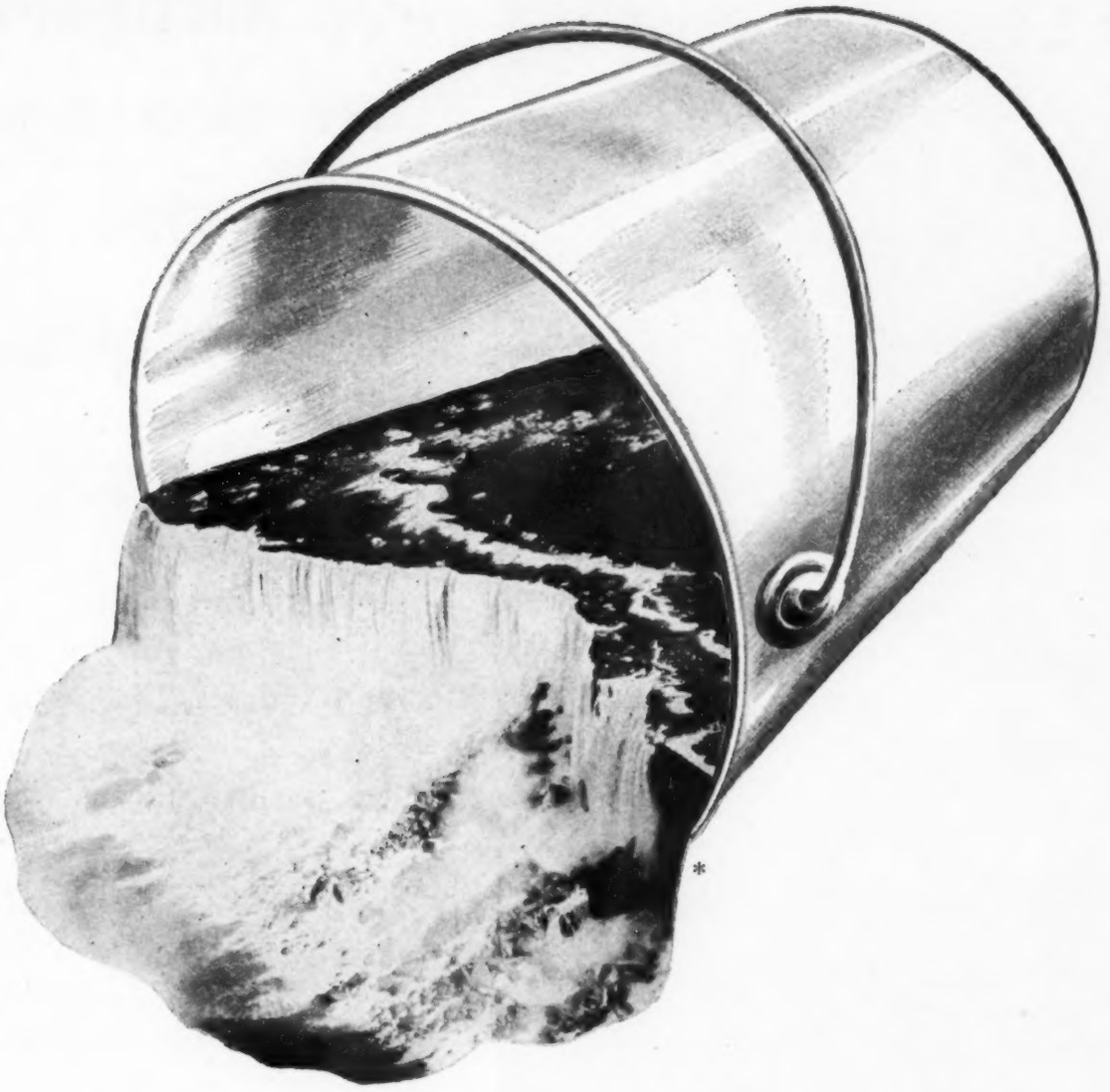
NEW TORONTO, ONTARIO	Eighth Street



ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY *General Offices:* . . erbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • *In Canada:* ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.* 4-155



How to get *more work* out of water

IMAGINE 1,000 gallons of water doing a cooling job that previously consumed 47,000 gallons! Picture what that will mean to your water bill. And think how it will simplify your water supply problem.

The G-E Evaporative Cooler *can actually cut your water bills 90% or more.* For example, under some conditions where a conventional shell and tube cooler requires an average of 47 gallons per minute to dissipate up to 240,000 BTU per hour, a G-E Evaporative Cooler consumes only ONE gallon per minute.

Ask your G-E Distributor for full information on G-E Evaporative Coolers, Condensers, and other refrigerating equipment. He's listed under "Refrigeration Equipment" in your Classified Telephone Directory. *General Electric Company, Air Conditioning Department, Section 6695, Bloomfield, New Jersey.*

* U. S. A. A. F. Photo

GENERAL ELECTRIC

Industrial Refrigeration

1 Loading work in machine spindle (collet open) and bringing up stop in turret

2 A tap of the hand closes chuck and piece is securely held for machining

. . . RAPID OPERATION ON THOSE SECOND — Here's a typical on these Profitable WIRE

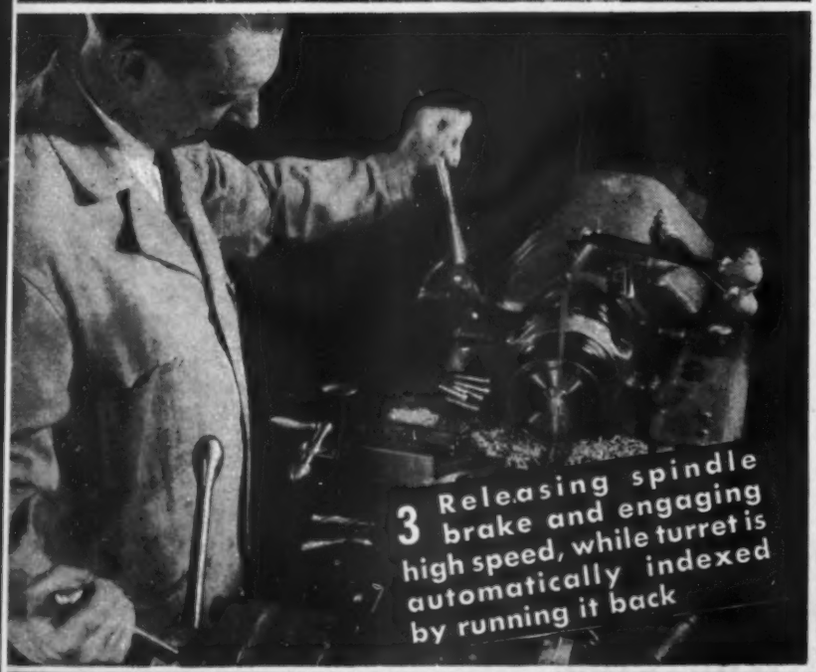
QUICK CHANGE-OVER—simplicity of set-up adjustments

SPINDLE BRAKE—integral with clutch lever

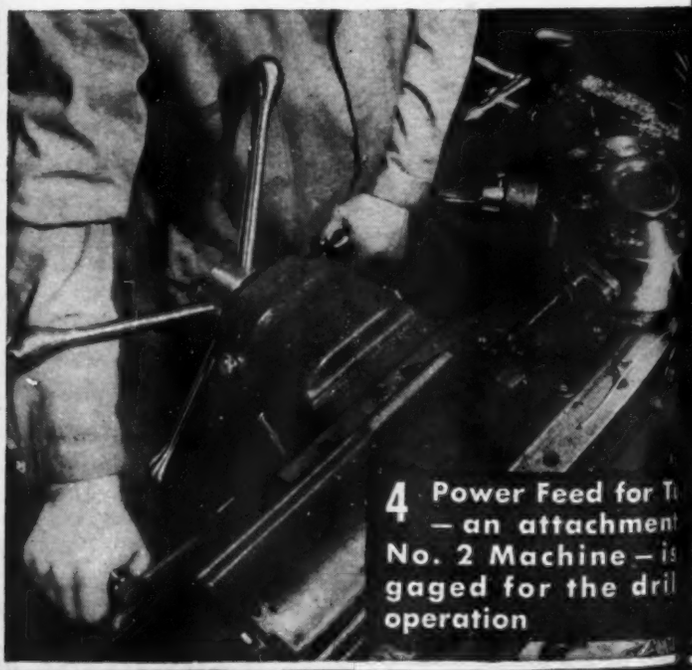
TRIP LEVER—opens or closes collet by power

20 SPINDLE SPEEDS—ranging from 3620 to 175 r.p.m. on No. 1 Machine and 2485 to 125 r.p.m. on No. 2

. . . **TOGETHER** with all the handy facilities for completing pieces from bar stock



3 Releasing spindle brake and engaging high speed, while turret is automatically indexed by running it back

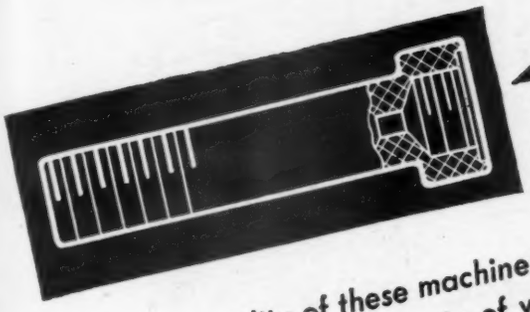


4 Power Feed for T — an attachment No. 2 Machine — is gaged for the dril operation

BROWN &

WITH MINIMUM EFFORT OPERATIONS TOO!

cycle of operations FEED SCREW MACHINES



Versatility of these machines to handle a wide variety of work and materials is profitable on **bar work,** also.

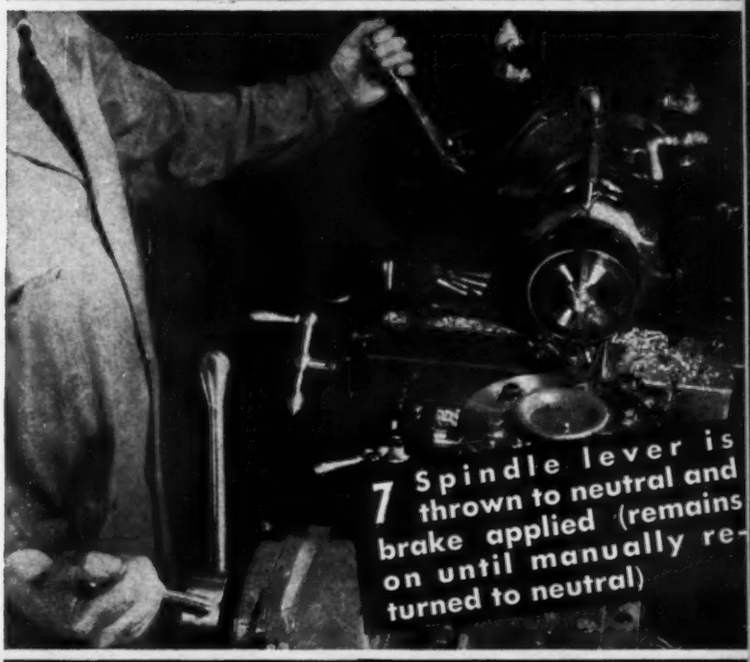
★ No. 1 Machine takes stock to ⅝" dia. (⅞" for light work).

★ No. 2 Machine takes stock to 1" dia. (1¼" for light work).

Ask for Booklet giving details

B·S BROWN & SHARPE MFG. CO.
Providence 1, R. I., U. S. A.

8 A tap on the trip lever opens the chuck and the finished piece is removed



7 Spindle lever is thrown to neutral and brake applied (remains on until manually returned to neutral)

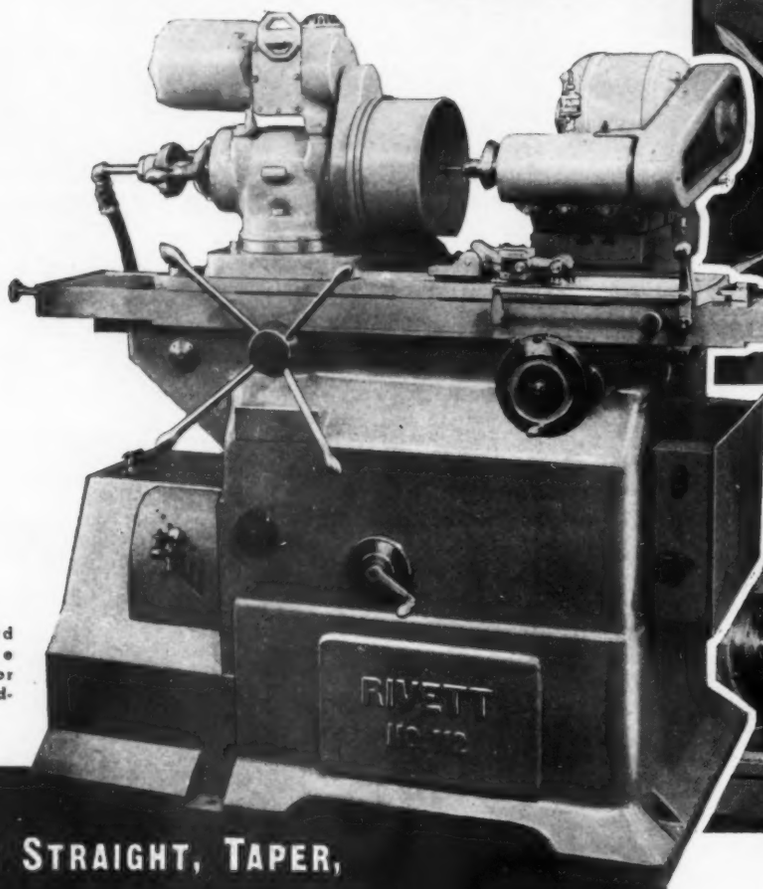
5 Spindle is changed to low speed and tap is advanced for tapping the hole

6 Spindle lever is moved to again engage high speed to remove the tap from the work

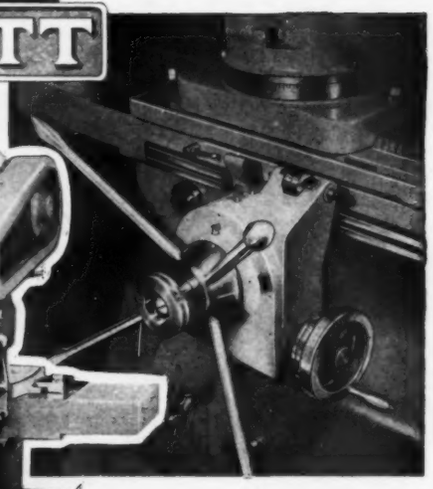
SHARPE

A MORE *Versatile* PRECISION GRINDER

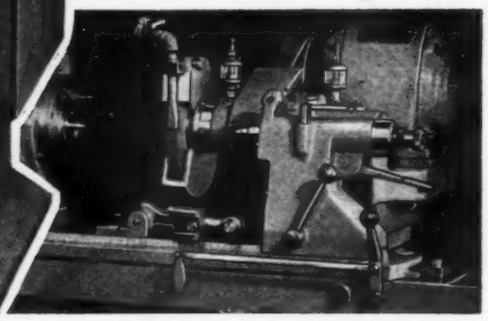
RIVETT



Standard machine equipped for internal grinding.



Fine table feed with micrometer stop for shoulder and face grinding.



Bracket with spindle for external grinding and tail stock for mounting work on centers.

FOR STRAIGHT, TAPER, BEVEL OR STRAIGHT AND BEVEL GRINDING

The Rivett No. 112 Universal Grinder is primarily for tool room work. Internal and external spindles, in combination with many adjustments, make possible a greater variety of precision operations. Extreme simplicity of design assures easy and efficient operation by even the lay machinist.

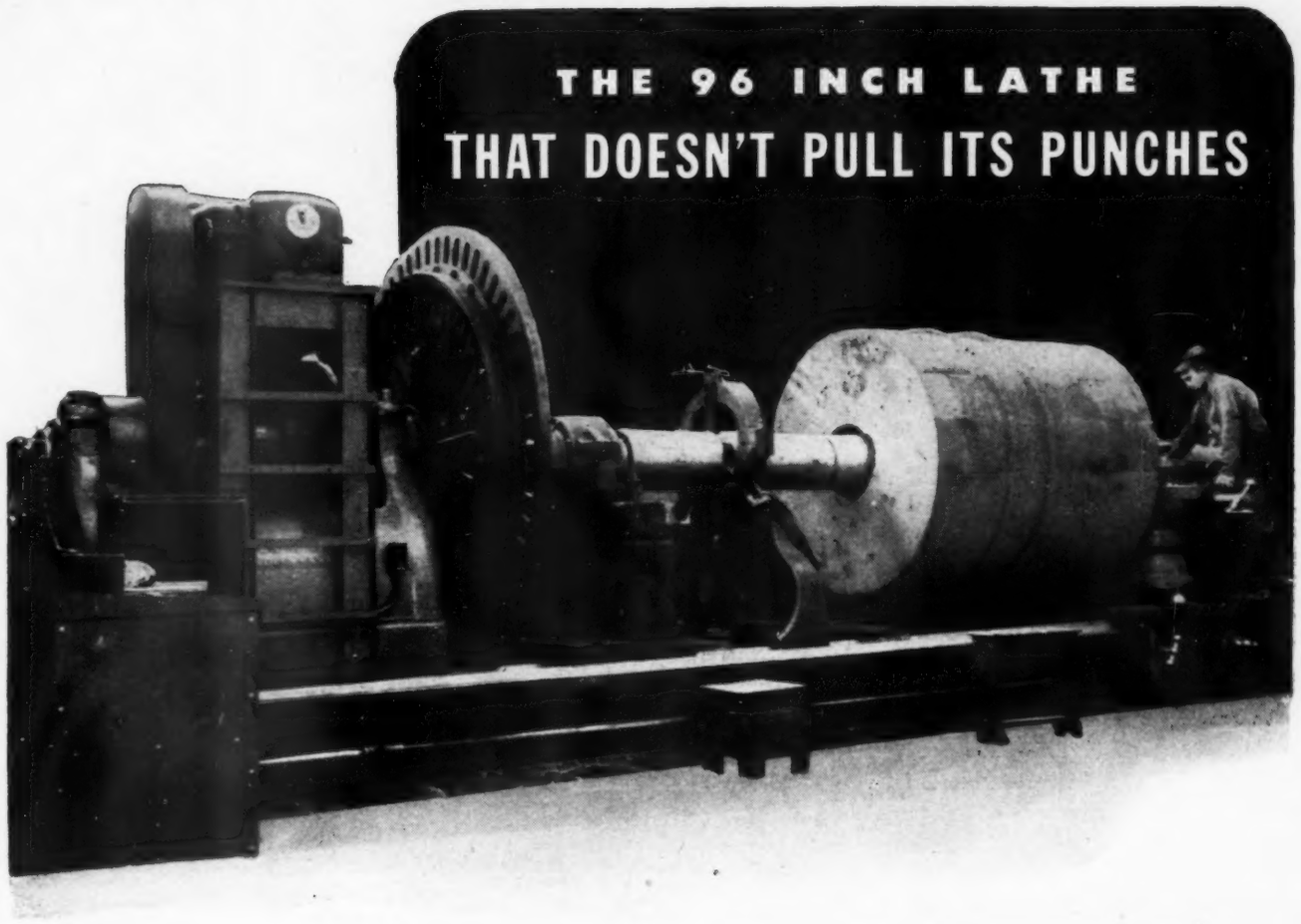
SPECIFICATIONS

Grinding cap., hole dia.	1/8" to 8"
Grinding cap., outside dia.	up to 8"
Automatic table travel	1/2" to 8"
Table speeds	18 selective
Hand table travel	16"
Swing over table	14"
Workhead swivel	90°
Table swivel	5°
Cross slide swivel	90°
Cross feed graduations	.0005"
Travel of cross slide	3 1/2"
Collet capacity	1"
Step chuck capacity	8"
Jaw chuck capacity	8"
Workhead speeds	
Spindle	150-450 r.p.m.
Dead center	100-300 r.p.m.
Grinding spindle speeds:	
Internal	5000 to 25000 r.p.m.
External	3300 r.p.m.
Automatic Oil Lubrication	
Net weight with motors	3700 lbs.

RIVETT LATHE & GRINDER INC.

ARMY E ★★ NAVY ★★

BRIGHTON, BOSTON, MASS.



HOW G-E NONMETALLIC GEARS TAKE SHOCKS AND ELIMINATE EXPENSIVE GEAR REPLACEMENTS

• This heavy-duty lathe in the plant of the E. D. Jones Co., Pittsfield, Mass., turns twenty-ton loads—huge, rough pieces that shock the gear drive when cutting tools hit high spots.

Metal gears couldn't take this intermittent shock treatment. Time after time high impacts shattered the intermediate gear . . . pieces of broken gear damaged the gear train . . . production was frequently halted for gear maintenance.

But G-E nonmetallic gears stopped this inconvenience and expense. Being 30 to 40 times as resilient as steel they withstand these shock loads. Gear failures are now things of the past . . . production is seldom interrupted.

If the gears in your machines are not giving satisfactory service, G-E nonmetallic gears may be the solution to your gear problems.

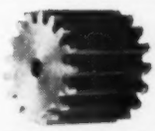
Contact your gear cutter for complete information. For the bulletin, "Silent Gears", write to Section Y-3, General Electric Company, Plastics Divisions, One Plastics Ave., Pittsfield, Mass.

GENERAL ELECTRIC
CD46-F3

Two types of G-E nonmetallic gears are available for a wide variety of applications

G-E TEXTOLITE for lighter jobs consist of woven fabric held in compression in a phenolic resin.

G-E FABROIL for heavy-duty applications consist of compressed cotton fibers held together by steel shrouds and threaded studs.



BOTH ARE SILENT, STRONG, RESILIENT

General Electric plastics factories are located in

FT. WAYNE, IND. • MERIDEN, CONN. • SCRANTON, PA. • TAUNTON, LYNN AND PITTSFIELD, MASS.

NOW . . .

A BULLARD CUT MASTER V.T.L. PUTS SPEED CHANGES AT YOUR FINGERTIPS

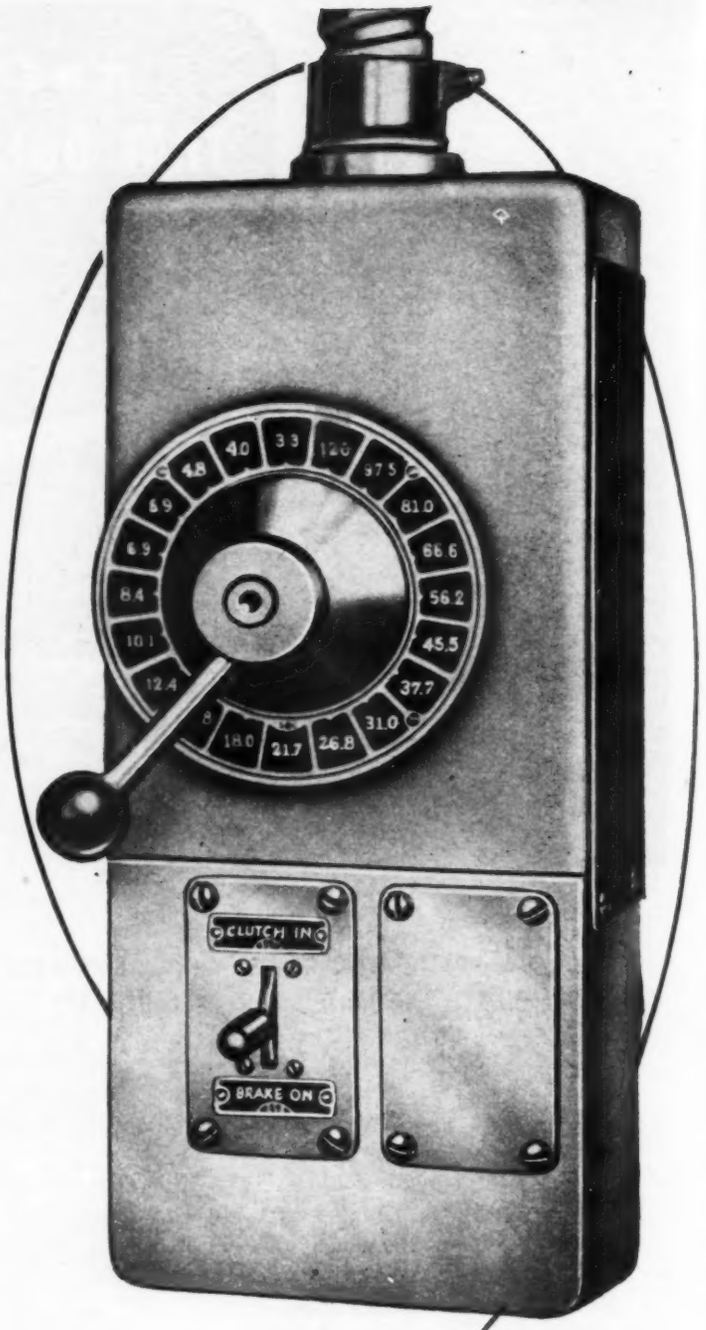
New Pendant Control with Speed Dial and Clutch-Brake Lever Located Where You Want Them

The addition of this entirely new and different Pendant Control to all Bullard Cut Master Vertical Turret Lathes provides a high degree of control and operating efficiency not found in other machine tools.

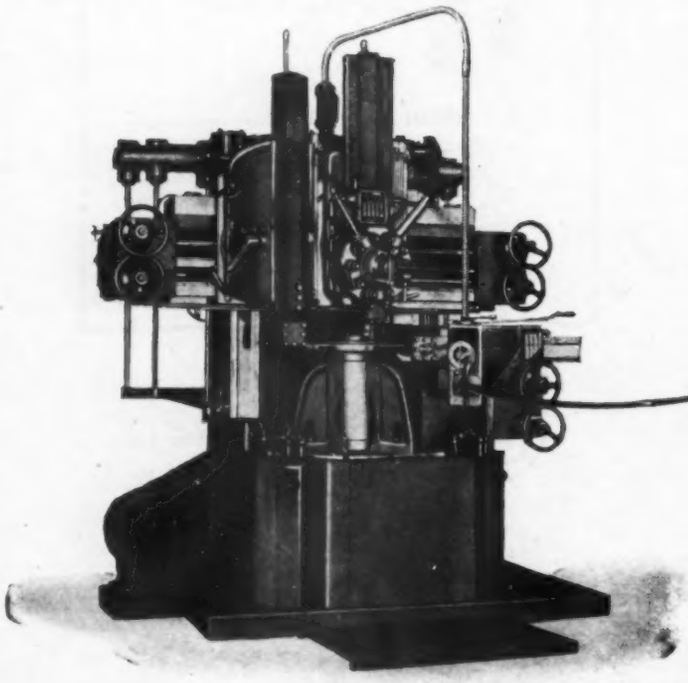
This is how the Bullard Pendant Control works. With the machine operating and a speed change needed, you throw the switch lever to "BRAKE ON" . . . rapidly dial the new speed (an exclusive Bullard Pendant Control feature) . . . throw the lever to "CLUTCH IN". That's all! . . . gears are quietly and almost instantaneously shifted through electrically-controlled, hydraulically-operated mechanisms. When you want to jog the table any fraction of a revolution for positioning or indicating, you merely manipulate the single switch lever.

This new Pendant Control is suspended at the most convenient operating height. It swings in an arc to whatever position is required for ease of operation.

For facts about other features that make Bullard Cut Masters your best investment *for cutting time on and between cuts*, write for Bulletin CVTL-4-1, today. The Bullard Company, Bridgeport 2, Connecticut.



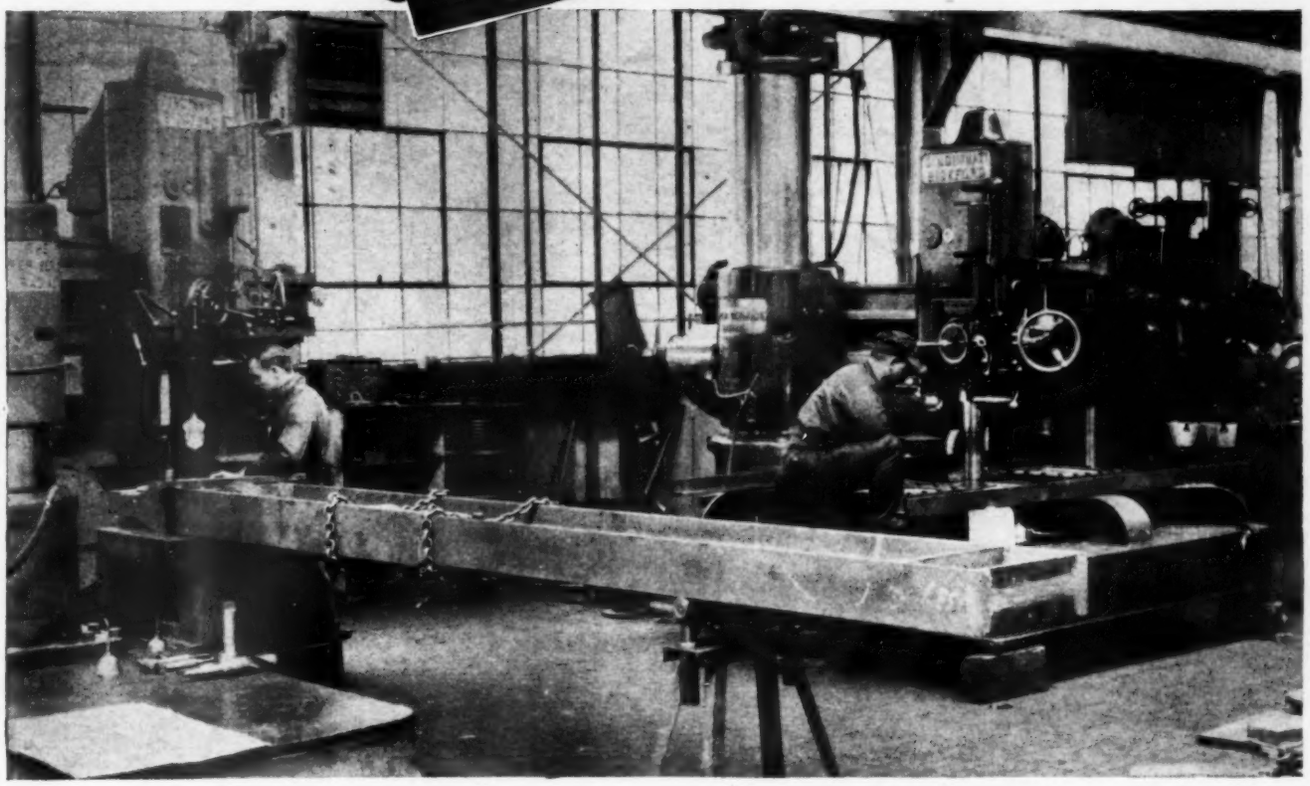
This unique Pendant Control is now a standard specification on all Bullard Cut Master Vertical Turret Lathes which are available in 30" and 36" sizes with two heads . . . in 42", 54", 64" and 74" sizes with two or three heads.



BULLARD

CREATES *NEW METHODS* TO MAKE MACHINES DO MORE

Performance PAYS . . .



• Courtesy of Chicago Bridge & Iron Co., Greenville, Pa.

A quotation from The Chicago Bridge & Iron Company:

"We have installed two Cincinnati Bickford Super Service Radial Drills at our Greenville, Pa., plant. They are especially well suited to our type of work, and we consider them to be excellent pieces of equipment."

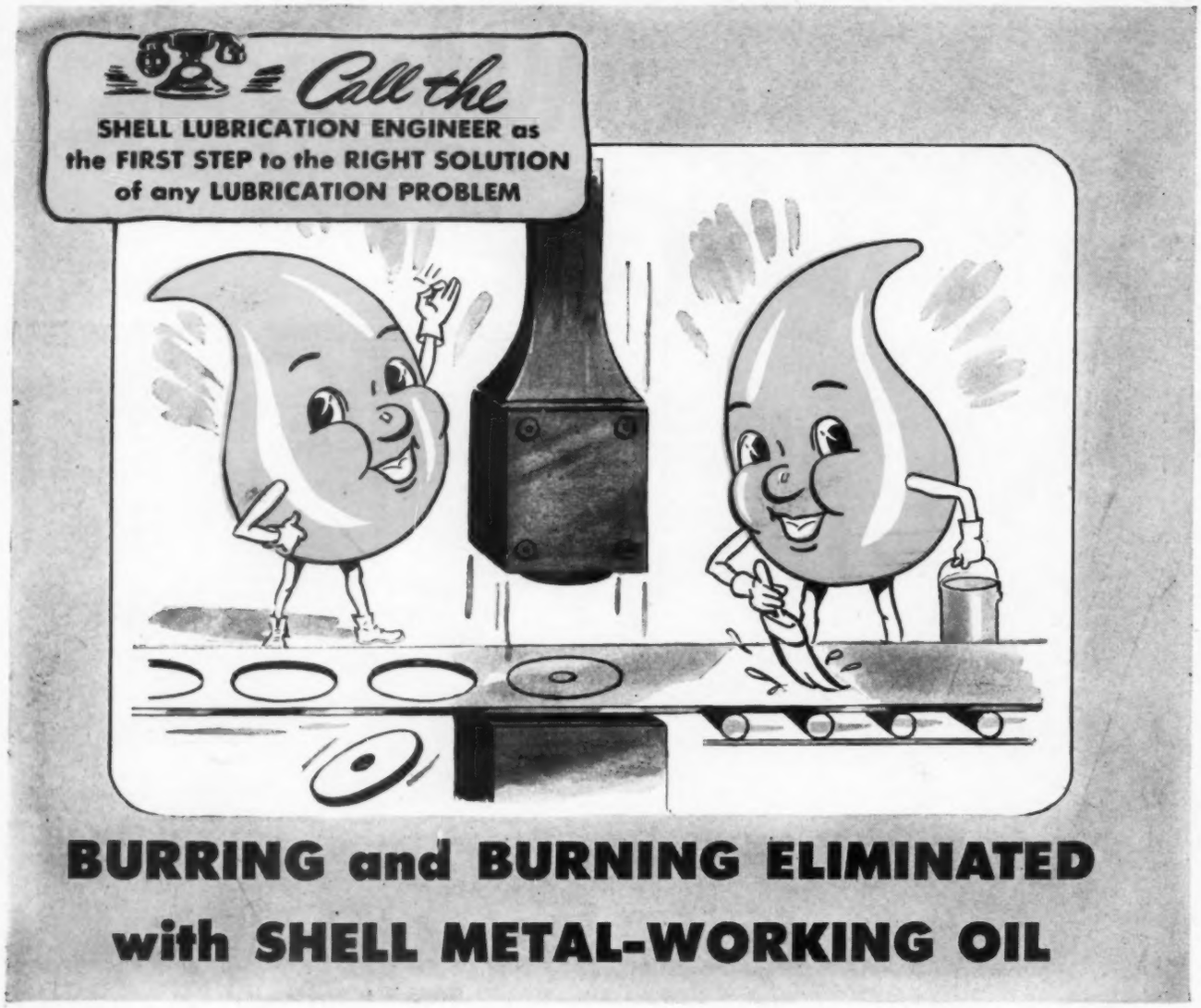
The advanced design and sound construction of Cincinnati Bickford tools pay in performance. Write for detailed Bulletin R-24A.

See our condensed catalog in Sweet's File

RADIAL AND UPRIGHT SUPER SERVICE DRILLING MACHINES

Equal Efficiency of Every Unit Makes the Balanced Machine

THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9, Ohio U.S.A.



BURRING and BURNING ELIMINATED with SHELL METAL-WORKING OIL

PROBLEM: Stainless-steel strip, 3" wide, ¼" thick (Type 4 SAE-51710), was used for simultaneous blanking and piercing butterfly valve parts with a mechanical-ram, sheet-metal press at the rate of 120 blanks per minute. *Unlubricated strip produced badly burred blanks—die was dangerously overheated.* Slower speed would solve heat problem but not burring.

SOLUTION: When the Shell Lubrication Engineer surveyed the problem he recommended a Shell Garia Oil. This was applied with a paint brush to the top of the strip, just ahead of the stamping. All burring and overheating ceased. Manufacturer completed 60,000 valve parts, at the rate scheduled, without renewing dies.

CONCLUSION: It pays to consult the Shell Lubrication Engineer, regardless of the nature or size of your lubricating problem. Write for informative literature on Shell Metal-Working Oils. Shell Oil Company, Incorporated, 50 W. 50th St., New York 20, N. Y. or 100 Bush St., San Francisco 6, Cal.

SHELL METAL-WORKING OILS

For every metal . . . for every operation

SHELL

American Machinist's Spot NEWS OF METALWORKING

Number of eastern molders and die casters are modernizing, reworking and replating their wartime molds and dies to meet peacetime production requirements. These steps are being taken to offset the paralyzing effects of ceiling prices.

UNRRA, after having placed large orders for new machine tools in this country, has adopted a policy of purchasing hereafter only surplus government machines. It is believed to have earmarked $10,000,000 for surplus tools in Canada and the United States. This reversal of policy is said to spring from protests made to the Mead Committee by used machinery dealers, who are seeking ways and means of getting in on UNRRA's business.

Automobile industry has produced only 800,000 cars since last July 1 instead of 2,500,000 as planned. It is four months behind schedule. There is slight chance that in the next few months it can get much above 50% capacity, at which it now is working.

Machine tool production is heading for $300,000,000 this year and may go higher. At this distance it appears that 1947 volume should get up to $225,000,000 as a minimum. Best prewar year totaled $185,000,000. Special-purpose machine builders are turning down foreign business because of the large pile-up of domestic orders.

> France expects to buy abroad 40,000 new machine tools, to build 140,000 in her own machine tool plants and to acquire 85,000 as reparations from Germany under her five-year plan for industrial reconstruction. French government plans to concentrate machine tool manufacture among fifty of the more efficient firms. Before the war France had 590,000 tools averaging 25 years in age. Over 50,000 were more than 50 years old.

Boeing is investigating high-strength material consisting of thin sheets of strong aluminum alloy, sandwiched with balsa wood, foamed hard rubber, foamed aluminum, glass fibre or other such substance. Airplane designers can hope for a true monocoque construction with this material, eliminating circumferentials, longerons, bulkheads or other stiffeners.

Woodworking machinery manufacturers have huge backlogs of orders, enough to keep them busy this year and probably next. Small tool makers' orders also are running at several times the prewar rate.

Washing machine company which had expected to make 1,000,000 units during 1946 has been compelled to revise downward its estimated year's production to 600,000 units. Revision is the result of the chronic shortage of parts and of strikes among suppliers.

For the first time anywhere, price of aluminum ingot has dropped below the price of copper ingot in England, a fact which is attracting much interest over here.

Bell and Douglas both have supersonic planes nearing the initial testing stake. It looks like Bell will do it first, with a ship expected to do more than 800 mph. Army Air Forces and National Advisory Committee for Aeronautics are planning a large research center in Washington State's Grand Coulee region to test full-size airplanes at transonic and higher speeds. Wind tunnel blowers would require 1,000,000 hp.

Mechanized handling of materials and redesign of plant layouts to reduce haulage of materials in process are being used by one of the country's biggest manufacturers as important means of cutting down production costs.

Washington is expected to approve shortly a plan whereby machine tool builders can acquire their own surplus machine tools at a negotiated price to be rebuilt in their own shops.

Developed for Mass Production

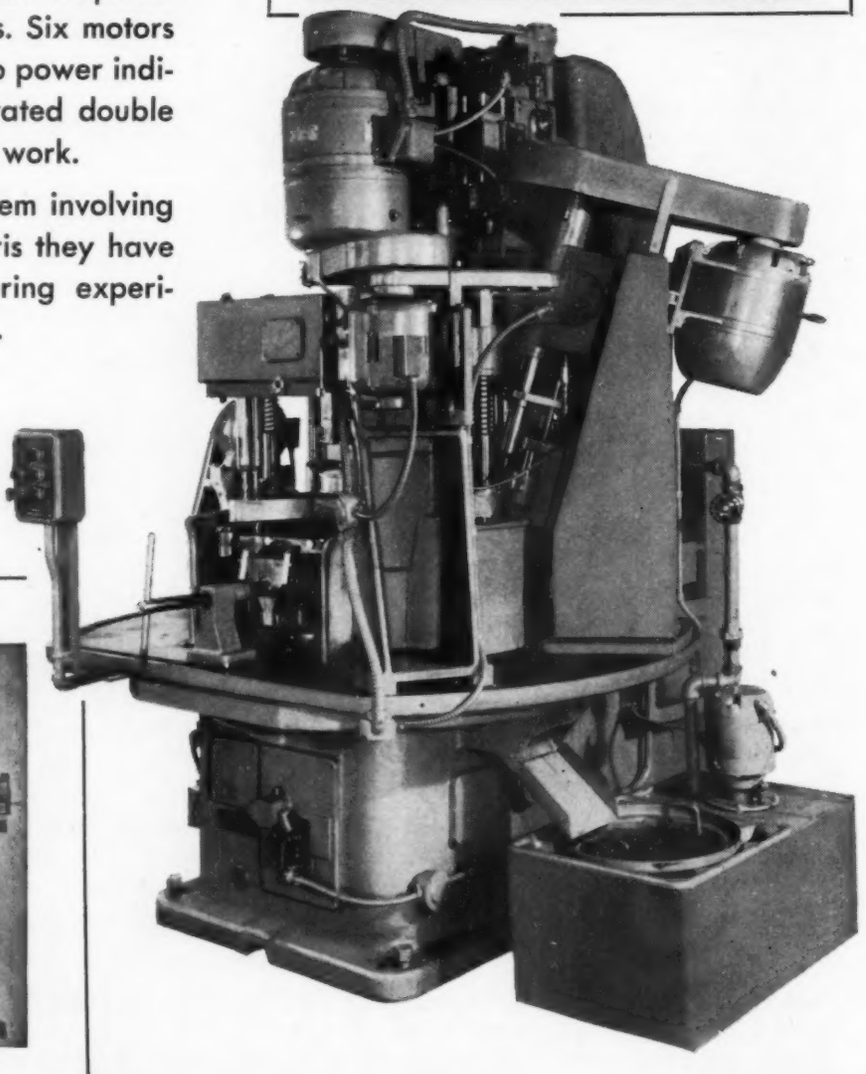
MORRIS MOR-SPEED

High Production Equipment

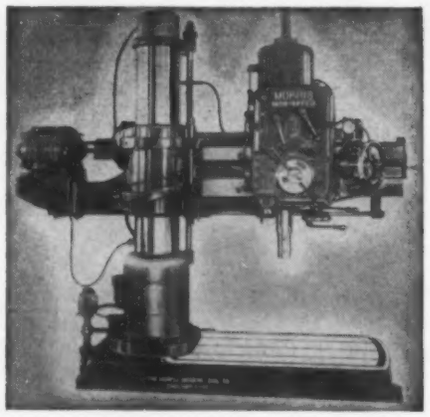
● This is a Hydraulic 6-station, automatic indexing multiple spindle, drilling machine developed by Morris for the high production of oil pump parts.

Although the machine is essentially vertical type construction it is complete with horizontal, vertical and angular units. There are 5 drilling—2 spotfacing—2 countersinking—2 reaming—and 2 tapping spindles required to complete cycle of operations. Six motors of various capacities are used to power individual units and six hand operated double holding fixtures for holding the work.

If you have a production problem involving several operations consult Morris they have the "know how"—the engineering experience—the facilities to help you.



MORRIS MOR-SPEED RADIAL



Builders of MOR-SPEED *Radials*

The MORRIS *Machine Tool Co.*

CINCINNATI 3, OHIO

ESTABLISHED 1877

American Machinist

BURNHAM FINNEY, Editor

Dare We Hope?

Reading the newspapers these days, you get the impression that everything is going wrong. Instead of contemplating serenely the state of the union, you conclude that the union is "in a state." And you think the world, as well as ourselves, is in a fix.

This is no time for a defeatist attitude. We came through the war meeting every challenge. We must come through the peace meeting every challenge both in our national and our international affairs. To do otherwise signifies no hope at all for the future.

There is hope, however, if our leaders—in goverment, in Congress, in industry, in unions, in blocs of all kinds—recognize and are willing to be guided by certain basic considerations:

1. A third world war is not inevitable. Another global conflict looms only when men and nations set up policies on the assumption that another war is coming. We must think in terms of making the peace work, not in terms of using today's time to prepare for the next war.

2. In helping to keep the peace, we must assume the responsibilities which are ours as a result of our economic and financial leadership. We often say that we do not know what Soviet Russia will do next. Does the world have any clear idea of what we will do next? World stability is unattainable without a consistent, stable policy on our part.

3. World-wide recovery is dependent upon America's production of goods. Full production here is essential not only to our prosperity as a nation, but also to world prosperity. It will be the forerunner to full production in other countries.

4. We cannot achieve full production or meet our international obligations so long as any person or group here at home insists upon a "rule or ruin" policy and so long as our public officials think of politics first and of their country second. Ours is a highly integrated economy. The shutdown of one segment soon stops other segments from functioning and complete paralysis sets in. No person or group should tamper with this interdependent machinery for selfish purposes.

5. Our democracy can continue to exist, and we can recommend it to the rest of the world, only so long as the ruling principle is the greatest good of the greatest number. One-sided laws, privileges for cliques and profits for a few at the expense of the many are in direct contradiction of democratic rights.

The present national and international scene is dismal, to be sure. Every pressure group leader, from Washington to Moscow, is smacking his lips as he gets a little more "for the boys" out of the economic trough. And here at home every two-by-four politician is slinking down in his chair, afraid to take action to prove that the government still is bigger and stronger than any one element within the country.

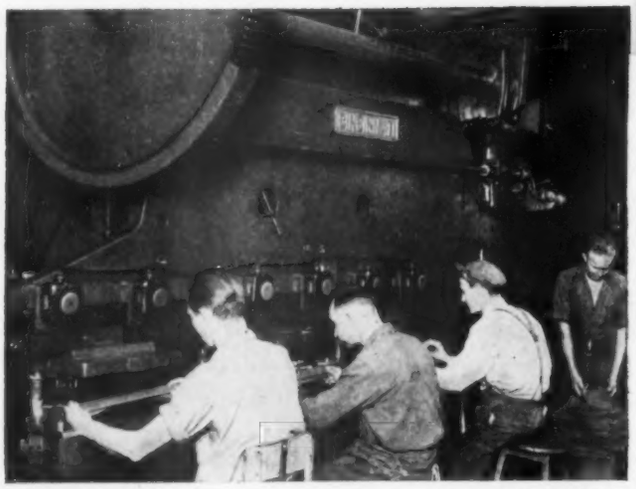
Both our nation and the world have been in messes before. We are in one up to our necks now, one which threatens to engulf us. Our only salvation lies in the hope that before it is too late the basic considerations herein outlined will prevail. Surely that is not too much to ask.

Burnham Finney

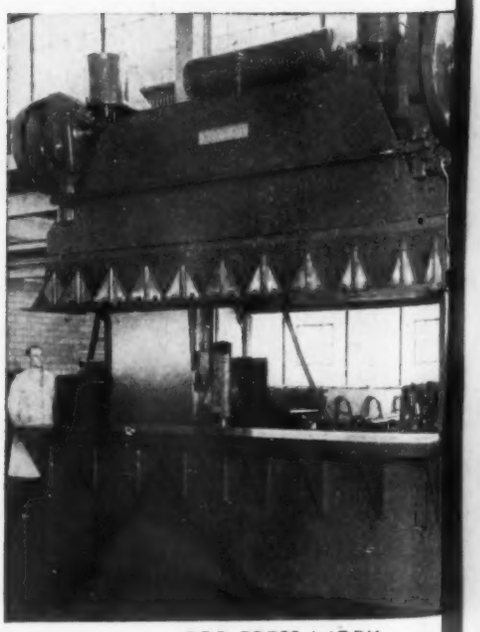
Use a Press Brake...

FOR BENDING

FOR MULTIPLE PUNCHING



FOR PROGRESSIVE FORMING, PUNCHING, NOTCHING



FOR PRESS WORK

Many a job is best on a Cincinnati Press Brake. This versatile machine forms, bends, corrugates, punches, notches . . . using simple low-cost dies for jobbing work, or progressive and multiple dies for quantity production.

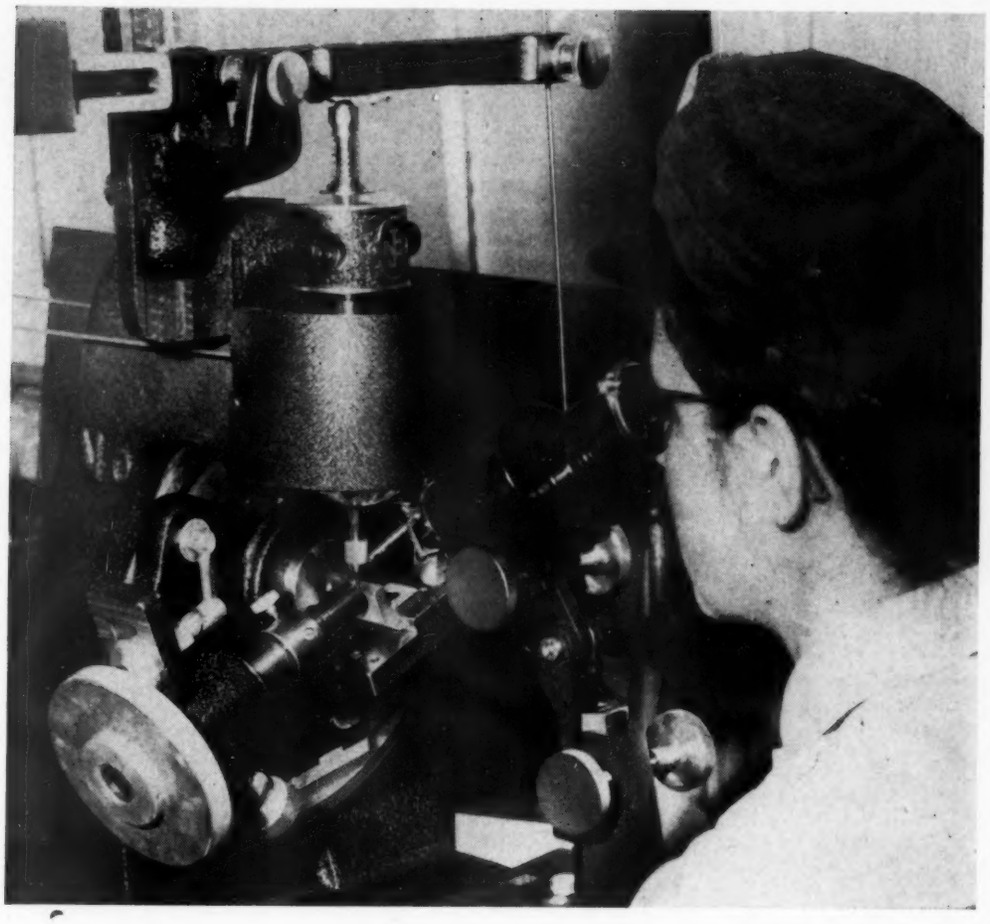
Its wide utility reduces manufacturing costs . . . its unusual accuracy pays on the assembly line . . . it's a producer of double dividends.

Write for Brake Catalog B-2.

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO U.S.A.

SHAPERS · SHEARS · BRAKES



Drilling orifices in diesel-engine fuel-injection nozzle. Seven orifices, equally spaced around nozzle tip, are drilled 0.0065 to 0.0073 in. in diameter and at an angle of 75°, ± 30 min. with centerline of nozzle. Freehand drilling with flat drill, rigid fixture and binocular microscope for good vision holds tolerances

Practical Precision in Miniature

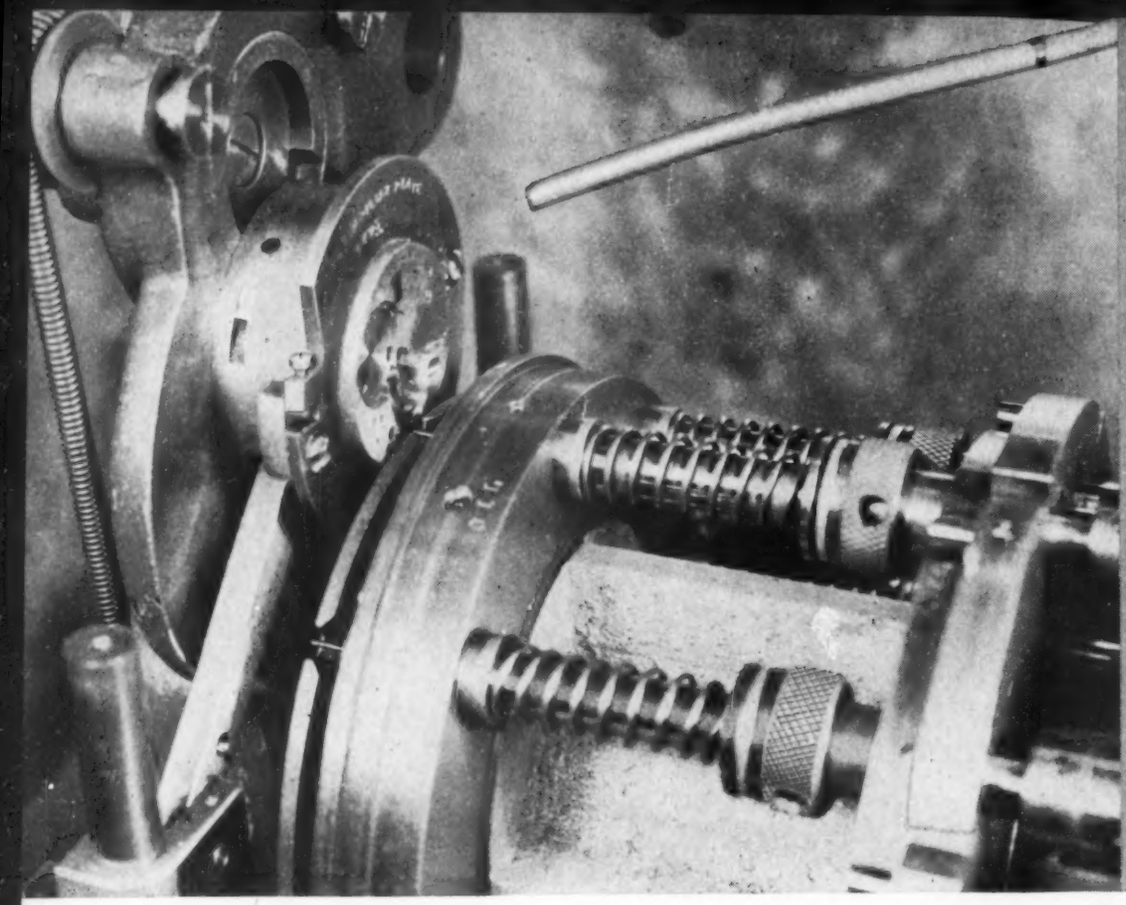
BY HARRY S. WHAREN
ASSOCIATE EDITOR

Hamilton Watch, American Bosch and Kollsman Instrument combine to reveal the secrets involved in drilling 0.004-in. holes and tapping 0.008-in. ones to ultra-close tolerances in production

HOLES as small as 0.004 in., just larger than a hair, drilled every day as a regular production job... Tapped holes with minor diameters of 0.008 in. and 338 2/3 threads per inch . . . A company specializing in such fine work that one worker, when asked to tap a ½—13 hole, said, "Are taps made that big?"

That is precision drilling and tapping. For many years, makers of fine watches have worked to such sizes and extremely close tolerances, but it was only during the war that demand for accurate instruments and other equipment gave impetus to this particular field. To bring you the latest information on this subject, which will grow increasingly important as new machines are designed, as speeds of production and transportation are increased, as the need is felt for more accurate instrumentation, the *American Machinist* has made a survey of practices followed by American-Bosch Corp., Hamilton Watch Co. and Kollsman Instrument Division, Square D Co.

The manufacture of watches, instruments and such items as diesel-engine fuel-injection nozzles not only require working in small sizes but also to tolerances measured in ten-thousandths of an inch and smaller. Close tolerances are necessary, too, as a fuel pump, for example, must



Pillar plates of watches are spotted in spotting dies and drilled on automatic machines. The drill plate carrying the pillar plate is mounted on two arms controlled by stepped pins in base of machine. Pins position plate correctly as drills index and advance in predetermined sequence governed by cams

measure portions of oil as small as one-tenth of a drop, as many times as 9,000 a minute, and then inject them into the diesel cylinder at tremendous pressure—from 3,000 to 10,000 psi.

DRILLING

Drilling of small holes requires certain drills and practices not in general use in larger work. For holes from 0.004 to 0.012 in., flat drills offer the best results, whereas for holes larger than 0.012 in., both flat and twist drills are used. Holes as small as 0.00025 in. have been drilled with flat drills, but purely as a special rather than as a production job.

Flat drills vary considerably in dimensions according to manufacturer, but usually are made with point angles from 90 to 120°, a slight rake of only a few degrees, a web thickness of approximately 1/3 the diameter and a flute length of 5 to 15 times the diameter. Tolerances on the drills are held as close as +0.0000, —0.0001 in. The larger drills may be ground in fixtures or free-hand on fine-grain wheels, such as Alundum 60M, whereas the smaller ones are ground free-hand on copper laps charged with diamond dust and oil. Accuracy of the drill itself, together with certain precautions in its use, afford tolerances of ±0.0002 in. on holes from 0.004 to 0.008 in. and ±0.0003 in. from 0.008 to 0.012 in. Above 0.012-in. diameters, tolerances of ±0.0004 in. can be held with twist drills.

Precision in small-diameter drilling depends on accurate, rigid spindles, true-running drills, rigid fixtures, and good vision of the work as provided by adequate lighting and microscopes or magnifying glasses. Drilling may be free-hand, with or without spotted parts, or with drill jigs. For small parts, jigs are needed, not only to guide the drills but to hold the parts during drilling. Thus, a part, such as a top bearing plate for an altimeter, would be jig drilled, whereas a fuel-injection nozzle could be held in a fixture on a drill press and drilled free-hand. Higher-production jobs, such as watch pillar plates, can be drilled in automatic machines. A pillar plate, for instance, is first spotted by spotting dies, the included angle of the spots being made less than the drill angle so the drills center themselves on the sides. Both sides are spotted to avoid too many spots on one side and possible distortion of the plate. Then by grouping the holes to be drilled according to size in order to get a surface speed as close as possible to 55 fpm. on each drill, the plate is drilled in a series of operations on cam-controlled machines.

In free-hand drilling, the drill, whether flat or twist, must be true-running to avoid any walking, eccentric holes and drill breakage. Truing of a drill is an extremely important operation and must be done carefully and accurately. On the National Jet precision drillpress, used at American-Bosch for drilling fuel-injection nozzles, flat drills are trued under a 20x binocular microscope mounted on the machine and adjustable to suit the operator. Drills suggested for this machine are hardened from their point up to approximately the middle of the large shank. As the drill is trued by bending the shank, it must be chucked only on the soft part of the shank, that is, with less than half its length in the chuck.

The drill is trued by turning the spindle by hand to bring the drill to its extreme runout position and setting the vertical hairline of the microscope in line with the edge of the drill shank. The spindle is revolved again by hand until the drill shank moves the maximum distance from the hairline. With a small notched screwdriver the drill shank is bent to halve the distance between hairline and shank. By readjusting the hairline and repeating the bending, the operator can bring the edge of the shank into almost perfect alignment with the hairline as the drill is revolved.

Operating procedure also affects accuracy of the holes. Pressure exerted on a drill should be carefully controlled to maintain tolerance and avoid drill breakage. The crossarm of the National Jet machine, for example, is adjusted until it is horizontal or nearly so during drilling,

and the counterweight on the operating lever is positioned to allow the lever to descend slowly with spindle rotating and no pressure applied.

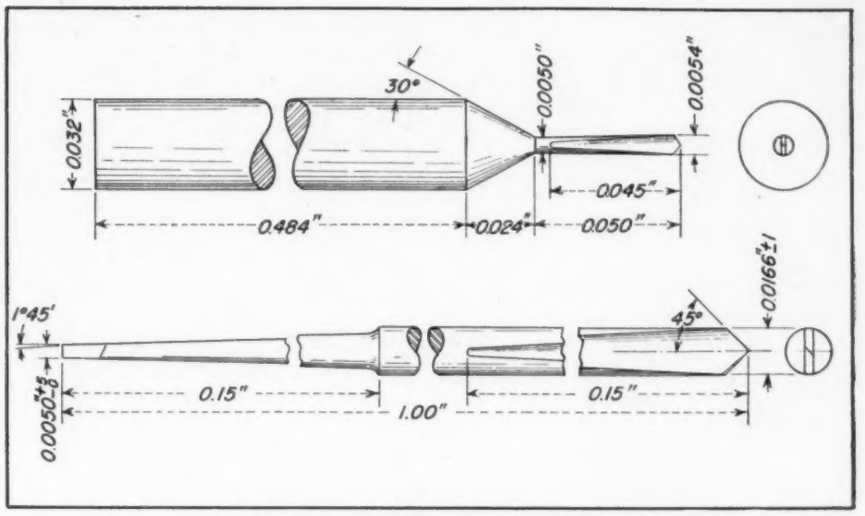
At the instant a drill point touches the work, there should be no pressure exerted on the lever. Any definite pressure at this moment will cause walking of the drill, whereas a perfect spot will result if the lever is properly balanced. Once the spot is made, drill feed should be smooth and steady with an up-and-down finger movement on the operating lever. Each time the drill travels approximately three times its diameter, it should be retracted and brushed with oil.

As with all precision work, both drill and work must be kept clean and it is for this purpose and as a coolant, rather than as a lubricant, that oil is brushed over drill and work. The kind of oil seems to matter little, as long as it has a light body. Light spindle oil or sulphurized cutting oil works well when applied by camel's hair brush or the frayed end of a match or toothpick.

Drill Breakage

Drill breakage can be controlled to an astonishing degree by careful truing and feeding. With a uniform web thickness near the cutting point and an accurately trued drill, there will be little breakage unless the drill strikes an exceptionally hard spot in the metal being drilled. In this case, the drill usually breaks at the fillet between the small and large shanks. If the web thickness is not uniform near the point, the drill is likely to break just above the point and be so difficult to remove from the hole that the part must be scrapped if it is made of steel. If the part is a nonferrous metal, the broken drill can be etched out.

Drilling speeds in general practice increase as drill size decreases. This is true for drills as small as No. 80, which may operate from 12,000 to 15,000 rpm. The smaller sizes of drills, however, give better results on steel parts when speeds are considerably reduced. In an investigation to determine proper speeds, American Bosch operated small drills up to 55,000 rpm., but finally set 2,600 rpm. as the best speed for drills from 0.004 to 0.012 in. in diameter. At this speed, breakage is negligible with proper practice; and a drill, before wearing dull, can average approximately a hundred holes in SAE 3312 steel with hole depths varying from 0.016 to 0.10 in. This average has been exceeded (in one case a drill having drilled through a total of 14 ft. of alloy steel) but not in general production work. Speeds up to 20,000 rpm. may be employed for brass and other soft metals.



Examples of single- and double-end flat drills with dimensions given to indicate general proportions of such drills

Small holes are checked by wire gages supplied in such lengths that they may be broken or ground off at the end when worn and then advanced in their holders. To hold tolerances of ±0.0002 in., Class A gages are needed with tolerances on the Go gage of +0.00002, —0.00000 and on the No Go gage +0.00001, —0.00001. Checking of such gages can be accomplished in Sheffield visual gages and should be set up as a continual operation in the work area.

When drilled parts must be heat-treated, a lapping or cleaning operation follows the heat-treat. Such holes may be cleaned by a revolving wire charged with a lapping compound that removes scale but no stock.

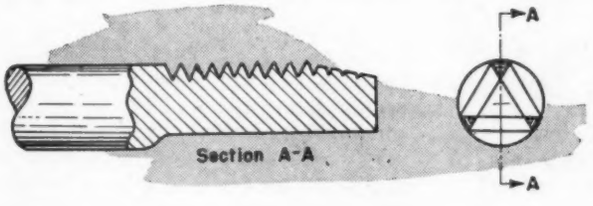
TAPPING

In the tapping of small holes, many of the problems experienced in larger work are encountered, plus particular ones relating only to small work. The size of the taps, especially in watch and instrument work, requires different practices in manufacture and use. The wide variation in thread forms and dimensions used by different companies has so far prevented standardization of tap manufacture and has compelled most users of extremely small taps to make them in their own shops.

Thread Forms

Among the thread forms and sizes used in the manufacture of instruments and watches are the standard American National Fine thread from size 00-96 and larger, AN Coarse thread to a more limited extent, and a variety of special forms and sizes, each manufacturer of such equipment having developed his own pet system. Thus, three leading American watch manufacturers have had three series that resembled one another only in having 60° thread forms. Pitch diameters and pitches varied widely. Hamilton, however, has now adopted a new series based on the Swiss NHS thread but transposed into inch units from the metric system.

In a 3-year investigation, in conjunction with the American Standards Association, thread series of various manufacturers were studied. As it is generally agreed that a geometrical rather than an arithmetical progression is desirable in thread series, they were plotted, diameter against pitch, on log paper to reduce the preferred curve to a straight line. Wide variations and gaps were found in all the series in use in this country, but the NHS series plotted as practically a straight line, therefore was subsequently adopted by Hamilton and is now being used in all new



Small watch tap with three flat flutes ground to bottom of thread. Tap is chamfered over last few threads

designs. It has not yet, however, been adopted as a standard by A. S. A. Dimensions and tolerances of the series are given in the Reference Book Sheets of this issue.

For thread sizes from 0.0118 to 0.0354 in., or 0.3 to 0.9 mm., the angle of thread is 50° whereas it increases to 60° for sizes from 0.394 to 0.0787 in., or 1 to 2 mm. Pitches vary from 338 2/3 to 63½ threads per in. over the same range, the pitch depending more on space limitations and root strength than on strength of thread.

To adapt the series to production work, it has been necessary to set up tolerances for the shop to follow. This has been done on the 50° series, the tolerances varying from 0.0006 to 0.0016 in. on major screw diameters, 0.00045 to 0.00120 in. on pitch diameters and 0.0008 to 0.0020 in. on minor nut diameters. Retaining of these close tolerances will depend on their practicability as shown by shop performance. Gaging of the threads may be accomplished by the three-wire method, wire sizes and maximum and minimum measurements over the wires having been established to hold tolerances on the pitch diameter.

Tap Shapes and Tolerances

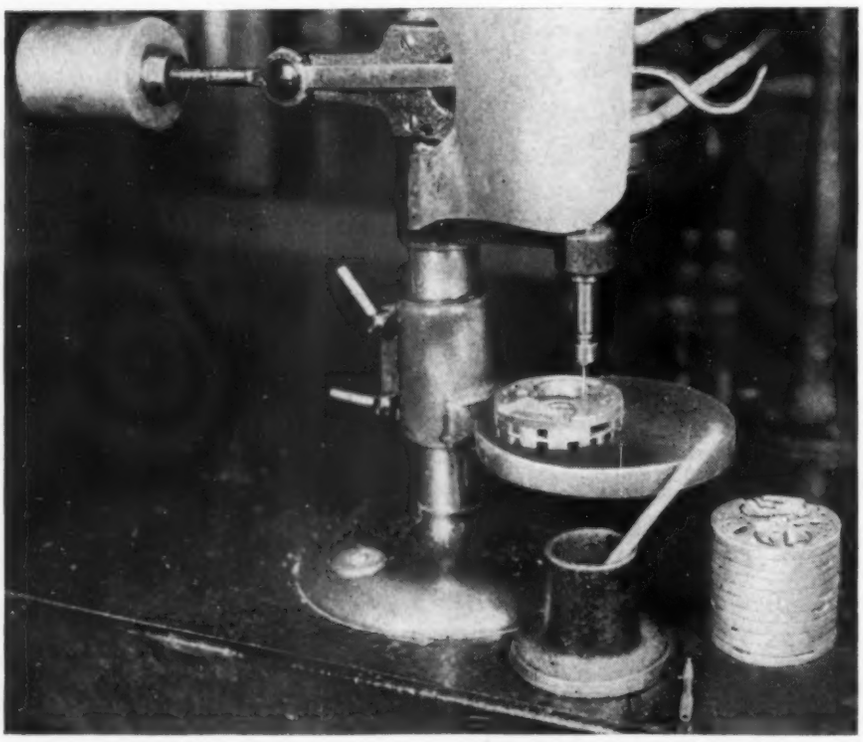
Taps for small holes fall into two classifications: those for machine screw sizes for 00-96 and larger, and smaller ones as used in watch and instrument work.

Machine screw taps, based on the American National thread form, are available with cut or ground threads. Inaccuracies in cut threads resulting from warpage and distortion in heat-treating seem to magnify themselves in the tapped work, especially in high-speed tapping. Ground taps, however, are more accurate, as they are ground from stock already heat-treated. Although they are more expensive than cut taps, they will produce many more holes before wearing below size and, as a result, may be more economical per tapped hole. Ground taps are supplied as commercial-ground and in four grades of precision-ground. The principal difference between commercial- and precision-ground taps is that the latter are held to closer tolerances on the pitch diameter.

Class 1 and 2 thread fits can be maintained with cut or commercial-ground taps, but for class 3 fits for sizes 00 to 12, precision-ground taps of No. 1 tolerances are generally preferred. Kollsman Instrument Div., however, is producing class 3 fits in general production work with commercial-ground taps.

The number of flutes per tap varies according to size and material being tapped. For sizes 00-96 up to 2-64 or 3-56, two flutes give the best results in all metals, as they provide greater chip clearance. This may be considered as one of the most important factors in selection of small taps. A combination of wide flutes and narrow lands provides maximum chip clearance and minimum frictional resistance, but may lead to difficulty in holding close tolerances as the lands afford little support. Narrower lands may be used for tapping soft metals, such as aluminum, copper and brass, than for hard, tough metals such as alloy or stainless steels. Flutes of all taps should be made as smooth as possible to allow easy flow of chips and to avoid any clogging that might break the tap or cause it to cut oversize.

For sizes from 2-64 to 10-32 or slightly larger, machine screw taps with 2 or 3 flutes and spiral points are suggested, as they are stronger than standard taps and require less power for tapping. The shear angle on the point may vary from 15 to 20° over a length of 2 to 2½ threads with a chamfer relief of 0.002 or 0.003 in. Wider lands and narrower flutes may be used on spiral-pointed taps as the chips, being forced ahead, will not clog in the flutes on through-hole tapping. The wide lands, however, may cause some loading of the tap in soft metals.

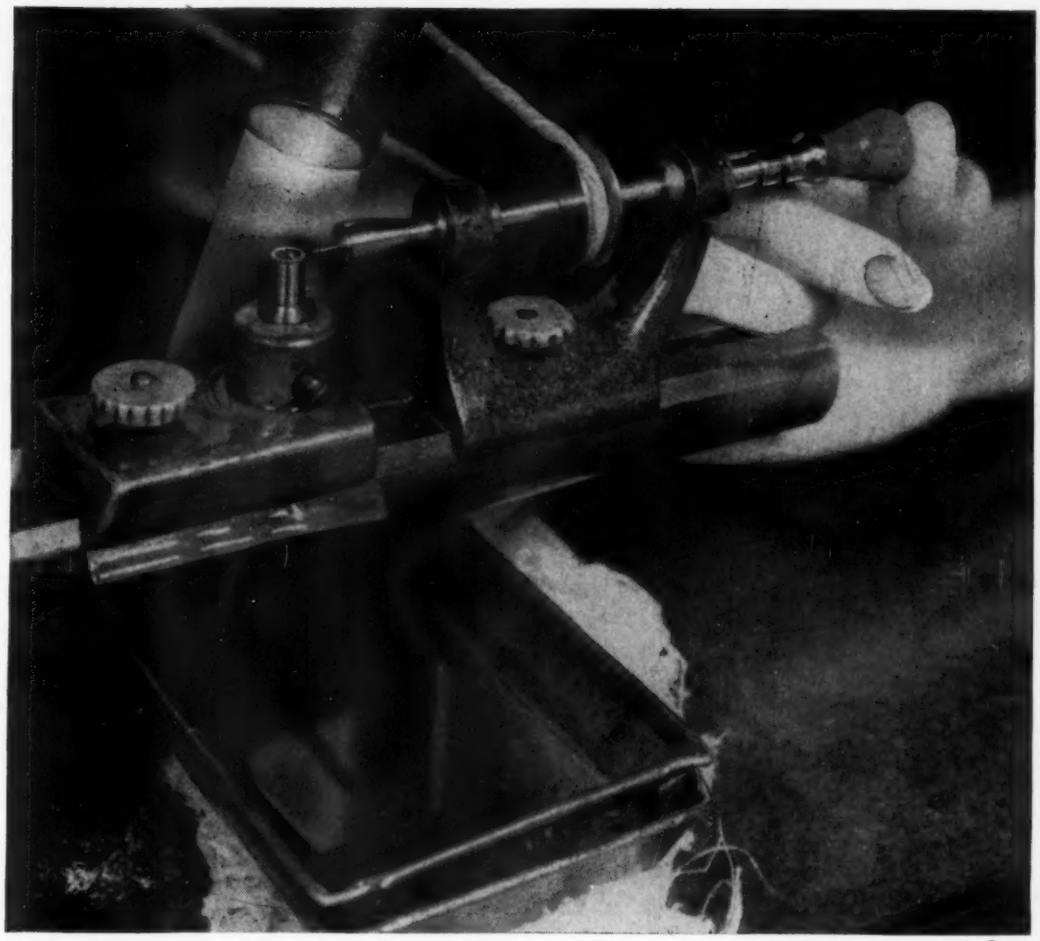


Free-hand tapping of watch pillar plate is aided by guide plate on which pillar plate is mounted. Cutouts in bottom of guide plate engage a table pin that aligns drilled hole with machine spindle. Cutouts in top of guide plate provide clearance for taps

Percentage of Thread

Important as the flute is in its effect on tap breakage, equally important is the percentage of full thread as determined by size of tap drill. Too great a percentage not only requires more power in tapping but imposes greater strain on the teeth of the tap. To avoid difficulty in this respect, Kollsman has set definite standards for machine-screw sizes to fit each material. From 65 to 75% is used for bronze, tool steel, drop forgings, stainless steel, cast steel and nickel copper; 70 to 75% for mild steel, cast aluminum alloys, cast iron and cast brass; and 75 to 80% for wrought brass, nickel, babbitt, wrought aluminum alloys, fiber, white metal and hard rubber.

The extremely small taps, 0.0118—338 2/3 and larger, are made with cut threads and either two or three flat flutes. Two flutes are recommended, as they provide better cutting edges and closer tolerances; three flutes, having less-keen edges, may swell small holes. At Hamilton, the taps are threaded on a watchmaker's lathe, hardened in oil, and



Machine tapping of watch balance wheel at 8,000 rpm. requires light, sensitive machine and light feeding pressures. Careful operation permits tapping of as many as 2,000 holes without breaking tap

fluted and chamfered on a grinder having on its table guide pins arranged to give proper grinding angles for both flutes and chamfer. During grinding, the tap is held in an individual holder which is guided by the table pins as the tap is passed across the face of the wheel by hand. The chamfer may be carried over 10 to 12, 5 to 6 or 2 to 3 threads as required. Tolerance on the major diameter of the tap is held to +0.0001, —0.0000 in.

Checking of taps, either machine screw or horological series, is done by the 3-wire method on a supermicrometer or with a dial-gage instrument. Go and No Go thread gages may be checked the same way and should be checked often enough to insure that undersize gages are discarded before parts are scrapped. A floor check is desirable with all gages inspected every 40 hr. or less and always at every new setup.

Tapping Practice

Little trouble should be experienced in machine tapping if certain requirements are met. First, the tap must be sharp or it will load and dull rapidly. The machine for tapping small holes should be light and sensitive enough to reverse freely, the bearings should be in good condition and the spindle aligned with the table. A machine heavy enough for a ½-in. tap is too heavy for small work, as spindle weight, for instance, may be great enough to cause a small tap to cut oversize. Furthermore, instantaneous reversal is necessary when tapping fine pitches. It is important too that spindle weight and pressure exerted by the operator are not so great as to force the tap as the result will be a bell-mouth hole and lead errors. A good rule to remember for small holes is that a tap will find its own lead.

Tapping speeds and lubricants also affect the accuracy of holes produced, but vary widely between plants. In one plant all small hole tapping is done at 1,750 rpm., whereas in another plant speeds range up to 8,000 rpm. At this latter speed, tap feed and reversing are controlled manually with relatively little breakage, but efforts are now being made to develop automatic tapping machines to increase production and cut costs.

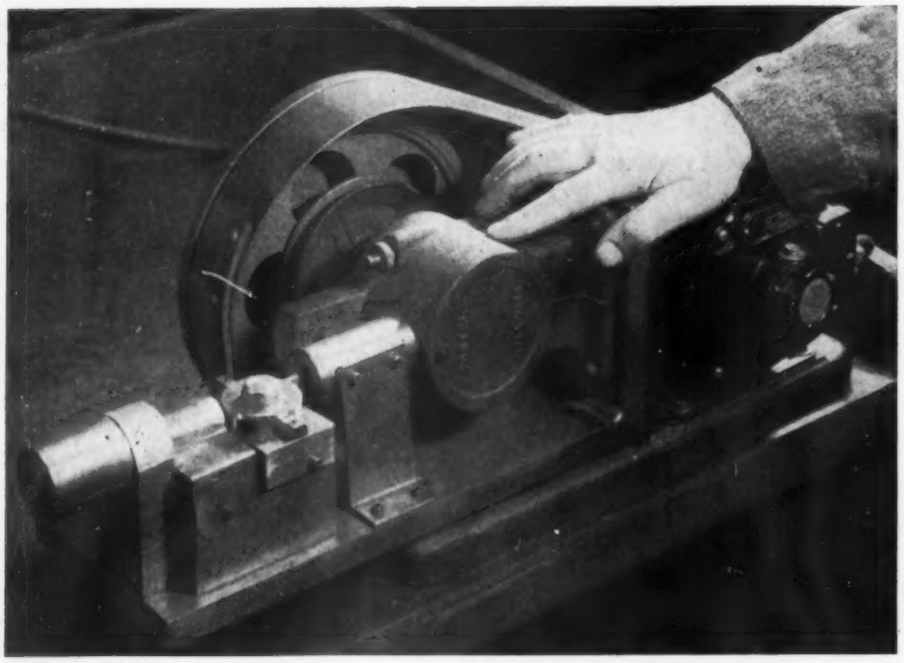
Tapping speeds depend primarily on the kind of material, depth of hole, keenness of tap, chip room in flutes and type of lubricant. In the extremely small sizes, taps cannot be operated to provide the surface speed ordinarily recommended with larger taps, but even with these taps as high a speed as practical will afford more accurate results, longer tap life and greater production.

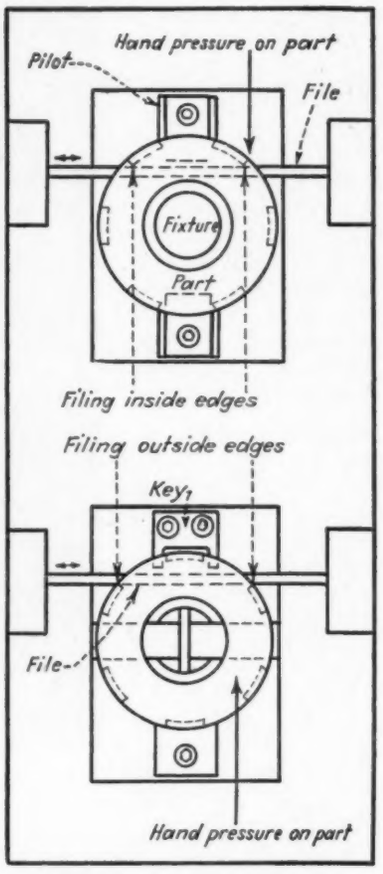
Among the lubricants found successful for use in tapping small holes are a mixture of cutting oil and stearic acid (10 gal. oil to 3 lb. powdered acid) for aluminum alloys; sulphurized oils for steel and nickel silver; lard oil for beryllium copper; the oil-stearic acid compound; a mixture of lard oil and kerosene or dry for copper and brass; and water or dry for plastics.

Discouraging

MANY SHOPS today have set standards of starting rates which give a man a financial licking for three months to a year. This discourages an all-around machinist and makes just one more bored operator.

SHOP SHOTS



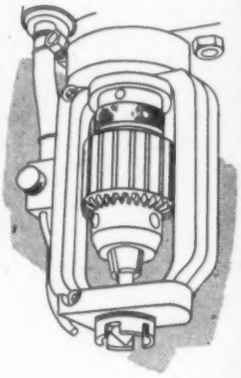


HOMEMADE FILING MACHINE TRIPLES CHAMFERING SPEED

TO ELIMINATE hand filing of inside and outside corners of steel thrust washers for a supercharger clutch, a Postel pump jack in an angle plate was bolted to a baseplate carrying a 1725-rpm., ¼-hp. motor. An 8-in. V-belt sheave reduced pitman speed to 400 rpm. An O-cut, 3/16 x ⅜ x 8-in. straight-sided file, with safe edges top and bottom, was attached to the pitman end, and guided by two bronze blocks flanking the fixture. Stroke is 1¾ in. Pilots and keys locate the work on the fixture, one set handling chamfering of outside edges, another the inside, as sketched. This setup did a better job three times faster, and is readily adaptable to other work.—*Russell C. Stanhope, master mechanic, Micromatic Hone Corporation.*

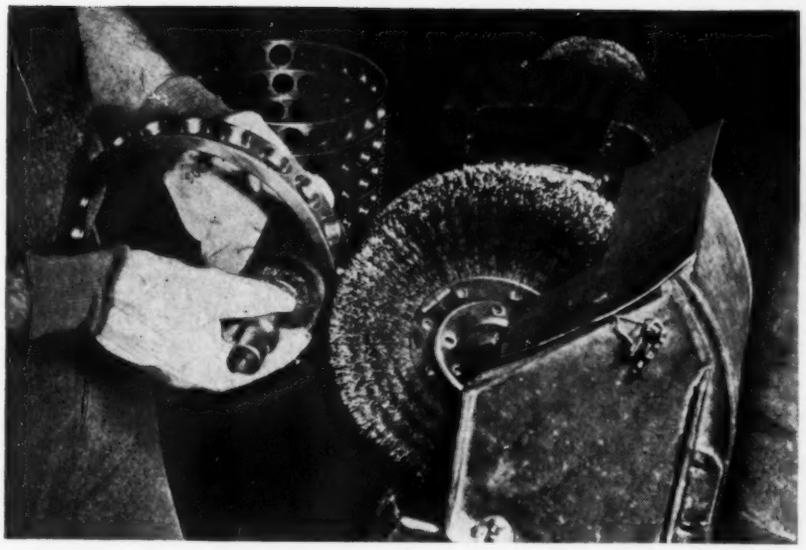
HINGED SPLIT YOKE CONTROLS DEPTH OF COUNTERSINKING

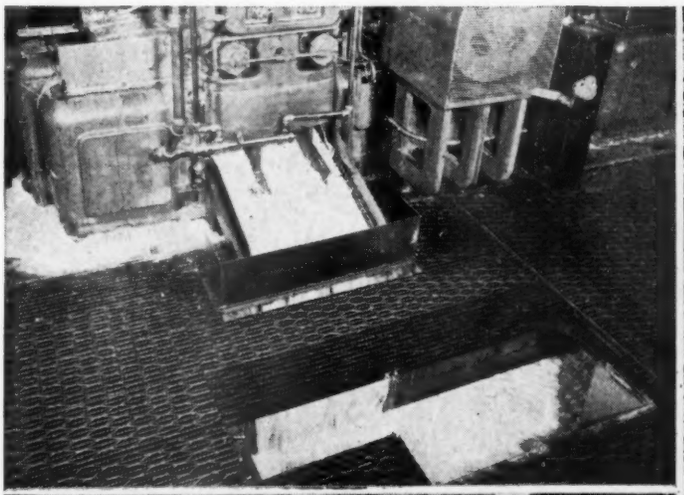
COUNTERSINKING often requires a more precise stop to control the depth of cut than the drillpress provides. This attachment is split centrally and hinged so it can fit over the chuck and clamped to the quill of a drillpress. A screw-in bushing adjusts the depth of the cut when the cutter is in the chuck. The advantage over column stops is that the effective travel is adjusted in the tool itself and bears no relation to thickness of work or motion of drillhead.—*North American Aviation, Inc., Dallas.*

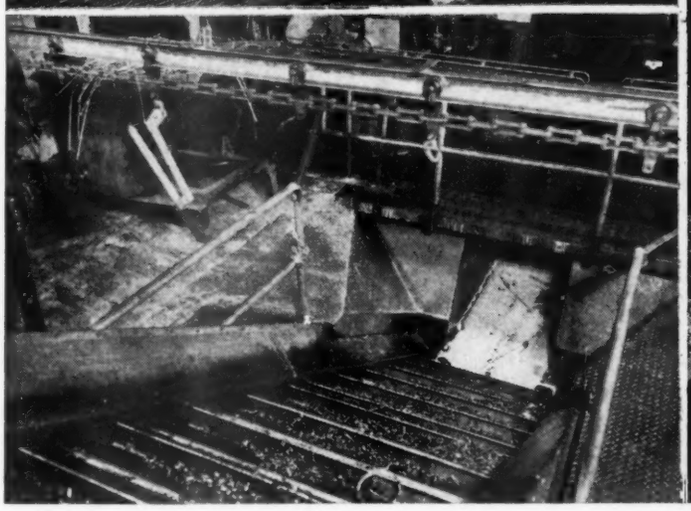


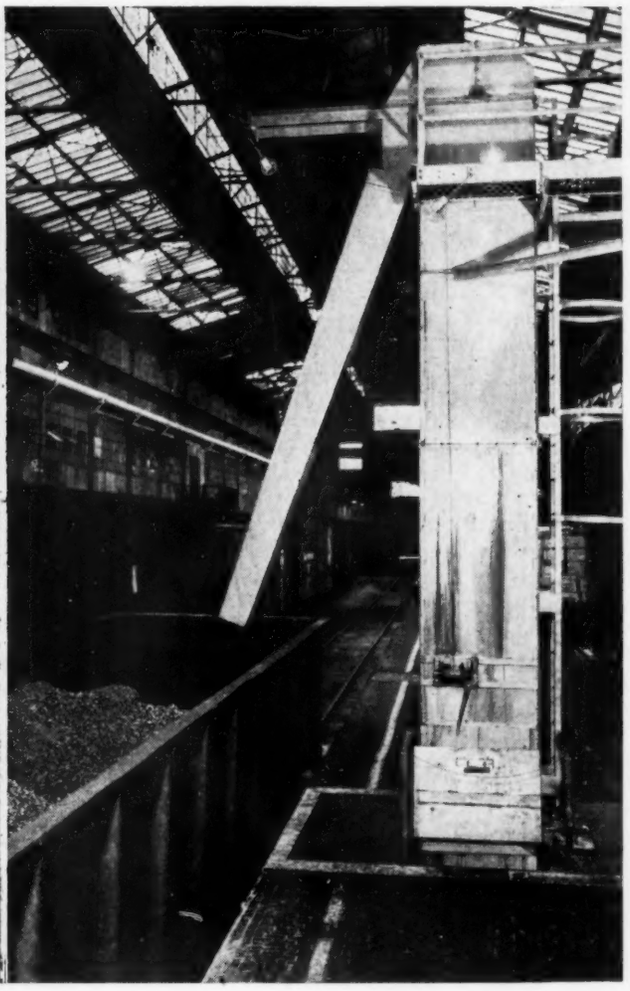
BRUSHES DEBURR RINGS FASTER

DRILLED HOLES in malleable-iron and bakelite ball-bearing separator rings are now deburred inside and outside at the same time with this power-brushing setup. Several Ringlock brush sections are mounted on an arbor, size and wire thickness depending on the work. The smallest has ¾-in. dia. brushes with 0.005-in. wire, the largest 2½-in. brushes with 0.005-in. wire. The operator holds rings on this stationary arbor against four Osborn 10-in. Monitor brush sections (0.0095-in. wire) rotating at 1800 rpm. on a double-spindle polishing lathe. Rotation of the larger brushes against the outside diameter of the ring spins it against the inside brushes. (Several small rings can be deburred at once.) This method is four times as fast as hand deburring—*The Marlin-Rockwell Corp.*



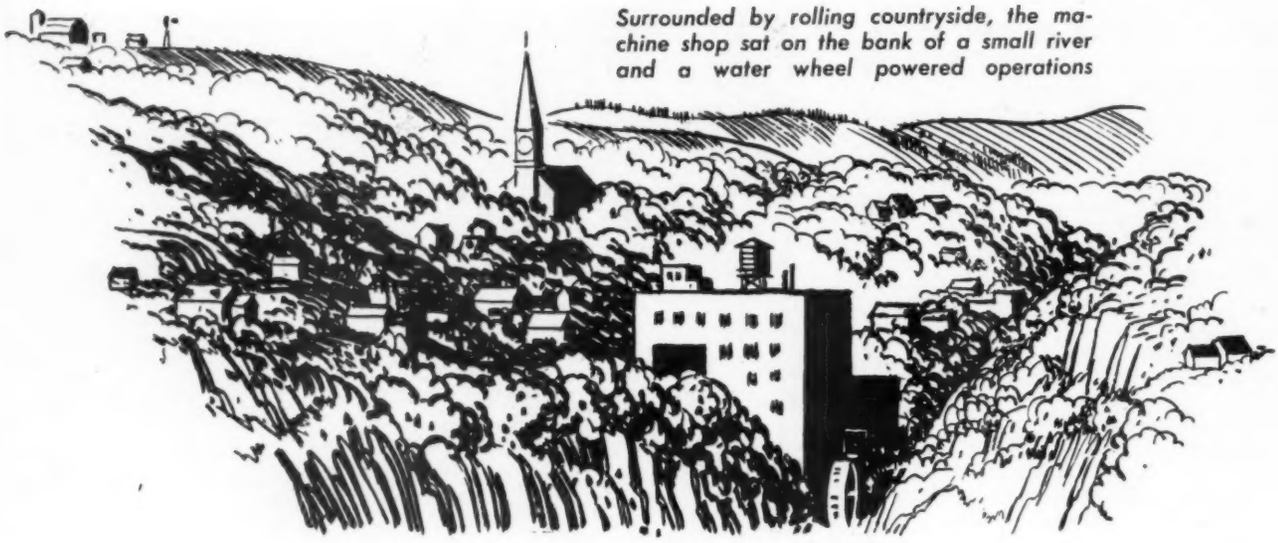






FOUR TONS OF SHAVINGS REMOVED PER HOUR

TYPICAL OF equipment required to remove the volume of chips produced by modern machine tools is this automatic salvage system which collects, prepares, and loads four tons of steel turnings per hour. Here's how it works: Below the floor between the rows of machine tools is a trough into which turnings are washed by the coolant, upper left. At the trough end, a conveyor, lower left, lifts chips and drops them into a chopper. An elevator belt then carries chips to the top of a loader from which they are spouted directly into freight cars, right. Two men operate the system. About ten tons of the chips are used in the Pontiac foundry each day; the rest is sold. —*Pontiac Motor Division, General Motors Corp.*



Surrounded by rolling countryside, the machine shop sat on the bank of a small river and a water wheel powered operations

Yankee Metalworking...1900

BY H. L. WHITTEMORE, M.E.

CHIEF, ENGINEERING MECHANICS SECTION, NATIONAL BUREAU OF STANDARDS

New England bears a reputation for two conflicting characteristics, ingenuity and conservatism. Here an apprentice of 50 years ago depicts "Only Yesterday"

THE TOWN, of a few thousand people, was surrounded by hills. In the fall, snow appeared first on the hills, gradually creeping down the slopes until everything was covered by a mantle of white. One hundred days' sleighing was the rule—from Thanksgiving to Easter.

Before sunrise on cold winter mornings it was not unusual to see two or three deer on the common pawing through the snow to get food. In the afternoons there usually were several sleds along the common piled high with cordwood, awaiting customers. Most sleds were drawn by a team of horses, but occasionally a yoke of oxen stood patiently in the snow.

The town boasted a cotton mill, shoe shop, and a machine shop—diversified industry—and was the largest shopping center for many miles around. People in the neighboring state were cut off from the town if an old covered wooden bridge burned or was carried out in a spring flood. Until a bridge was replaced, which might be many years, light vehicles crossed the river on a ferry pulled by hand along a wire rope stretched from shore to shore. It ran only infrequently from dawn to dusk.

This shop had grown like Topsy from time immemorial. Because water power was essential, the shop was on the steep bank of a small river that tumbled through the town. By the beginning of the century, most of the power load had been taken by a steam plant, but the water wheel still contributed its bit. The buildings, brick with wood floors, posts, and stairs, were two stories high on the street and six stories on the river bank. As the shop expanded through the years, some new machine tools were installed and other improvements made. Probably this shop compared favorably with other shops at that time. However, any shop man looking the place over was constantly reminded of Chordal's *Letters* written years before.

Old Al, perched on a tilted chair, remembered the specifications of a water wheel shipped many years before and brought order out of chaos

About this time an electric trolley line, for passengers and freight, was built, connecting the town with the railroad two or three miles away. Tracks were laid along the street in front of the shop and into the erecting shop. When a freight car was gently backed into the building, it always was a question whether the brake handwheel and the ladders would be scraped off the car. As one observer commented, "That car is a darned good drive fit."

One day the man who looked after the water wheel came to Old Tom, the superintendent, much concerned by the amount of trash on the rack in the intake. Tom, an uncommunicative old Scot, who learned his trade

in the Old Country, was not impressed and finally said it didn't make any difference. Measurements of water level back of the rack at noon showed that, when the gate to the water wheel was opened, the water level dropped 5 ft. Full head was only about 12 ft.

Soon the cotton mill, getting all its power from the same intake, had to shut down for lack of power. When the rack was cleaned, the trash formed a huge pile higher than a man's head.

Lost Records

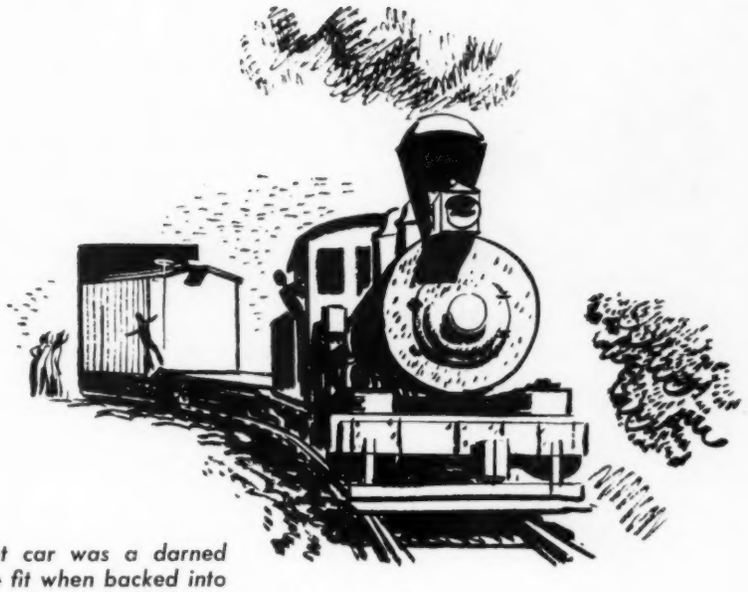
In the early days, the machine shop made a wide variety of machines for local industries. Everyone except a few of the older shop men had forgotten that the shop once made water turbines, until one day an order came in to ship RUSH one 36-in. runner for a mill up-country.

A search of the pattern storehouse turned up the patterns. Sure enough, there were two patterns for a 36-in. runner—one right-hand and the other left. Frantic search brought to light no record of which had been shipped on the original order. Finally, someone suggested that Old Al might know. He had been superintendent for years until an accident, from which he never fully recovered, kept him home most of the time.

Occasionally, on nice days, Old Al would hobble to the shop and sit around for an hour chatting with his old friends. When asked about the runner he was silent for half an hour, then agreed that a water wheel had been shipped to this customer. Very slowly, with long pauses, he described the customer and his horse and wagon. At last he agreed the wheel was 36-in. No prodding brought further information for a long time. Finally he announced that the wheel was left-hand and the order was filled to the satisfaction of everyone.

When Old Al was asked how in the world he remembered these data, he blinked for a minute and explained that, when anything was shipped, he took a piece of chalk and wrote all essential facts on his vest. For a day or two he looked at his vest frequently and repeated the information to himself. When he could repeat it correctly without looking, he brushed his vest, ready for the next order. Fortunately, business was not very brisk in those days.

Coming to work in horse-drawn rigs, shop men combined their own lunch hours with feeding their horses



The freight car was a darned good drive fit when backed into the building entrance

Employees

Many of the shop men owned subsistence farms on the edge of town and hitched up the horse to come to work each day. Rigs were parked in a shed back of the church across the street from the shop. At noon the men stepped across the street and fed the horses from the nose bags.

In winter these men came in open sleighs called "pungs." The thills were offset laterally so the horse trotted along in the runner track.

The work day was ten hours, 7 A.M. to 6 P.M., with an hour for dinner. Men living in town got to work after a heavy snowstorm by floundering through drifts to their waists before sunrise because the snow plows had not been around.

Hunting, and fishing for trout in the mountain streams were popular pastimes. In town, people played croquet.

Each year, about six recent graduates of engineering schools came to the shop at $50 per month to be trained. After a year or two they went to district offices as salesmen. Eventually some went to foreign lands: Australia, Japan, Russia. Although graduates were accepted socially by the townspeople, they were always considered fair game for practical jokes.

There were vague rumors that sometimes cock fights were held in the vicinity of the town. One young engineer made repeated inquiries, very carefully, and finally, after being sworn to secrecy, was sold a ticket for a fight to be held in Wilmot's barn about 15 miles out of town.

The other young engineers soon begged for tickets and, on the appointed evening, a horse-drawn barge with about two dozen men arrived at the barn. Amid much turmoil and the crowing of roosters the men gathered around the ring on the barn floor. They had been warned of the penalties if caught by the police.

After some delay, police in uniform suddenly appeared, blocking the exit, and declared the crowd under arrest. The engineers frantically escaped by windows well above the ground, landing in deep, soft, barnyard muck. They ran to the place they had left the barge—but it had been moved to the other side of the barn without their knowledge. In desperation they headed for town, alternately running and walking. The next morning in full daylight, they straggled into

Barnyard muck greeted young engineers as they jumped through a window to avoid the embarrassing questions of cops raiding a cock fight

town separately, looking much the worse for wear.

For months the town rocked with the tales of adventure that night.

Apprentice Training

Many apprentices had great difficulty reading drawings, and some work was spoiled on that account. One young engineer in the drafting room proposed evening classes in drawing and shop arithmetic. Several other young engineers volunteered to help. Comfortable quarters near the offices were fitted up by the company.

Enthusiasm in the shop was tremendous. Many more, both old and young, wanted to attend than could be accommodated. About a dozen, mostly apprentices, started coming two evenings a week. Drawing practice, with blackboard explanations, and many questions from the students went on for several weeks; then attendance fell off rapidly.

When this new development was brought to Old Tom's attention, he did not feel that apprentices should be either urged or required to attend. They were tired after working all day. Besides, attendance at evening classes was not part of the apprentice contract. Tom's passive resistance soon ended this promising undertaking. Perhaps he resented it as an attempt to undermine his authority.

Broken Flywheel

Some heavy-rim flywheels having six straight spokes were piled outside the foundry. One day it was noticed that some of the spokes were broken, apparently by tensile stresses. The foundry foreman was anxious to repair them by "burning." Molding sand was to be rammed around the fracture and molten cast iron poured through the mold until the ends of the spokes were molten, then the job left to cool. Old Tom would hear nothing of all this and insisted the wheels be broken up for scrap.

Later, we found out why. The first railway bridge across the Firth of Tay, two miles long, was at Dundee. It was a viaduct carried by cylindrical cast-iron piers having integral brackets supporting the track.

After it had been in service 18 mo. on the night of Dec. 28, 1879, there was a great gale, and, at the height of its fury a passenger train reached the middle of the bridge, then suddenly disappeared. It is believed that 75 to 90 passengers aboard the train perished.

Old Tom told how, as a boy watching the storm from a window, he saw the London Express, lights blazing, shoot out onto the Tay Bridge and, halfway across, suddenly disappear. Later, investigation showed brackets on the piers had broken. There was testimony that some brackets did not pour full and, to save the pier, the foundry had "burned" on brackets. He was very much opposed to any "burning" of castings.

The Chief Engineer

Ever since the very early days, the products of the shop were designed by the Old Man, who, in his shirt sleeves, toiled deliberately over the drawing board, laying out all new work. His long white beard, extending to his waist, must have interfered with his drawing.

Without any formal engineering training, he designed and built successfully an amazing array of widely different machines. Some were inventions to replace hand workers and others were improvements on existing machines. He was an excellent example of the ingenious Yankee for which New England is famous. His hobby was making and playing violins.

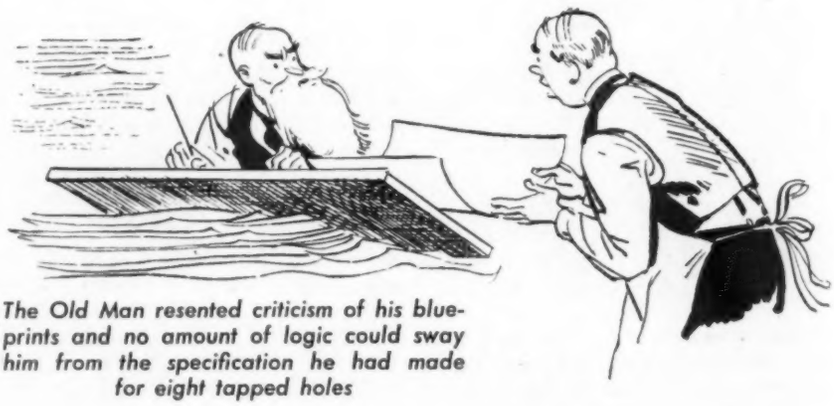
Everything connected with the drawings had to be taken up with the Old Man, although he had several assistants. This made it necessary to stand beside his table for some time before he would look up, rather displeased at being interrupted.

A typical case was the blueprint for an apron, a large steel casting requiring a lot of machining. It showed eight tapped holes for 1-in. clamp bolts, but the diameter should have been ⅞ in. If the holes were put in according to the drawing, as happened from time to time unless the foreman was right on the job, it was necessary to put in shouldered bushings and tap them ⅞ in.

The blueprint, with corrections marked in red, was taken to the Old Man and the trouble explained carefully. He put the print on a pile 2 ft. high awaiting attention. He was annoyed and said that the shop knew very well the holes were ⅞ in., they had made enough of these aprons to know.

Pleading with him to make the change proved futile even when four previous blueprints, showing the same error, were pulled from the pile at different levels. Perhaps the shop is still trying to get this mistake corrected.

If changes in a machine were made necessary by many complaints from customers, the Old Man took the pattern to the pattern foreman and explained just how he wanted it altered. Then he went to the machine shop and with the foreman decided on the changes there. Finally the improved machine was tried out on the test floor. Often it was changed in this way several times before the Old



The Old Man resented criticism of his blueprints and no amount of logic could sway him from the specification he had made for eight tapped holes

Man was satisfied. Then a boy from the drafting room came down and made sketches of the changed parts from which the tracings were drawn and linked. This all took time. One shipment of some large machines, for which the customer was clamoring, was held up several weeks. When the foreman in the shop was urged to ship, he grumbled he would be glad to see them out of his way—but it might be well to have drawings because replacement parts were sure to be needed later.

In the very early days, before the blueprint era, the Old Man made one assembly drawing of a machine in colored inks. This was set up in the shop and the machinists went to it for information. Dimensions, for which no figures were given, were measured on the drawing with a machinists' scale. Is it any wonder that the Old Man was annoyed by this constant turmoil about blueprints?

One machine, that went to many forlorn parts of the world, was driven by a 2-cyl., vertical steam engine having 6-in. stroke. The cranks were set quartering so the engine would start from any position. In many locations fuel and water had to be hauled by team to the machine from a considerable distance. Customers complained repeatedly that this engine was a "steam-chewer"

Absence of figures prompted use of a machinists' scale to measure dimensions on the drawing

and it was almost impossible to keep pressure on the boiler. Finally the protests got so emphatic that the company decided something would have to be done.

The vice-president asked one young engineer if he could take indicator cards from the engine. The engineer, a little annoyed at this lack of faith in his abilities, assured the official that he could do the job. The cards showed a sharp cut-off at quarter stroke for both ends of each cylinder and the usual expansion curve nearly to atmosphere, then, just before the end of the stroke, *readmission* to boiler pressure, followed by exhaust to atmosphere. It was evident that steam consumption was the same as if the steam had been admitted full stroke but the work done only about half that for full stroke. The steam for full stroke was four times that for cut-off at quarter stroke. There was much excitement. Investigation showed that the sheet-tin templet for laying out the edges of the ports in the valve chest had been made correctly many years before, but, that 20 to 30 years of wear by following the edges with the scriber, had worn them badly. The result was that ports in the valve chest were much too wide, causing readmission of steam at the end of the stroke. A new templet remedied the trouble for the time being.

Apparently even this experience did not convince the company that cards should be taken from each engine before it was shipped. If the engine seemed to run satisfactorily on test, out it went.

These incidents show quite clearly how slowly modern technology wormed its way into New England industry.

TIPS for Top Shop Men

70 Cooperate with other departments. Don't pre-judge a contact man. If he's a "wrong 'un," he'll dig his own grave without your getting blisters from a helping spade.

71 No man ever knows too much—except in spy and gangster movies. Soak up information like a sponge soaks up water. You'll find a use for everything you learn sooner or later.

72 It isn't easy to read technical material, in ads, articles and bulletins, and usually it isn't entertaining. But it does for you something you need done. Castor oil isn't pleasant either, but it gets results when results are needed.

73 The surest way to independence in authority is to know more than your job. Among other things, know some metallurgy, something about tooling, machine prices and characteristics, some of the engineering that goes into your plant's product. Then you can make your point with authority in any discussion, and can be of such real help in planning that you'll soon have some planning to do.

74 Beware idle machine time—nothing ruins low unit costs more quickly. Be on the alert for ways to speed loading and unloading, to reduce frequency of stops for tool changing or sharpening, to have work-checking done while the machine is running. Look for places to add a hoist, a roll feeder, a chute. Dial or twin fixtures always cut "down" time. Replace screw clamps with lever or cam clamps. Be sure tools are ground properly for the job and try honing the cutting edges to see if that doesn't make 'em hold up longer. Maybe a harder tool is indicated. And so on—whether there's a Methods Department or not, you can usually make suggestions they'll never think of—or are too busy or too "general" to see.

75 When you find a man who thinks, give him a chance to practice. Don't insist that he follow *your* method on every job. If he is given a chance, he may find a better, easier, or faster way. That helps him, helps you, and encourages others to think too.

76 The penalty we pay for over-specialization is lack of interest. When a worker did a variety of jobs under "one-of-a-kind" manufacturing conditions, his work kept changing and this helped his enthusiasm. Today, a job can quickly become humdrum, unless you can put interest into it. Try, for example, to show how the "little" job is vital in the finished product, and so on. It helps to change workers about.

Vibration Detective at Work

BY ROLLAND C. GRIFFITH
RESEARCH ENGINEER, THE HEALD MACHINE COMPANY

What causes chatter and how can it be eliminated? Here is an explanation, plus eight case examples, showing progress

CHATTER marks on finely finished surfaces can be caused by three kinds of vibration: *forced, shock* and *self-excited. Forced* vibrations are initiated by sources of power such as motors and pumps, unbalanced rotating parts, ball and roller bearings, gears and any mechanism which transfers energy in uniformly timed impulses. *Shock* vibrations are the results of acceleration or deceleration of masses, such as the machine table. Shock also originates externally from passing trains, stamping machines, and hammers. *Self-excited* vibration is present in many metal-cutting operations to some degree. Slowly moving tables and slides are often a source of self-excited or relaxation oscillations.

What is the significance of chatter? The average contour is not changed by chatter, and boundary friction has not been found to change appreciably. Dayton's work indicates that initial run-in should be improved by chatter marks. Measurements to an accuracy of 0.0001 in. are unaffected. However, the appearance is certainly altered, making visual inspection more uncertain. A ring gage will appear spotted, or banded after using a few times with chatter marks only a few millionths deep. During the war, measuring instruments with an accuracy of five millionths inch were used, but chatter marks with a depth of only a few millionths made measurement uncertain. Chattering reduces the life of single-point tools, and harder grinding wheels are required on a rough than on a smooth machine. Workmen exercise greater care in handling nicely finished work, resulting in less spoilage.

The tool and the work, under the influence of a common excitation, will vibrate at the same frequency but each with its own amplitude and phase. If the phase and amplitude are identical, no relative motion will result. However, any other values will produce relative motion that leaves chatter marks on the work surface. Each forced frequency will act independently, producing its own chatter and making trouble-shooting difficult.

The above tacitly assumes forced vibrations only are involved. Self-excited vibration resulting from the cutting operation will produce exaggerated chatter and will react upon the whole machine exactly as any other source of pulsating energy.

Shock vibration may be internal or external. The ideal method of mounting to guard against external shock is a soft mounting under the base. But as most machines are not self-supporting, a heavy sub-base is required. Practically, shock pads are made stiff enough so all the forced vibrations in the machine are below the mounting resonance frequency.

Internal shocks cannot be isolated. When they occur, each part of the machine acts as though struck by a hammer and vibrates at its natural frequency, gradually reducing in magnitude at a rate dependent on the damping. Chatter is invariably produced in this case, its depth a function of the impact. A rough belt produces an irregular series of shocks or repeated transients. These excite the spindle, resulting in a most confusing type of chatter, often not recognized as such.

The best solution for chatter produced by forced vibrations is to do away with the cause. Some progress has been made in this direction with induction motors and pumps. Induction motors have three major sources of pulsating energy: rotational unbalance, ball bearings, and the rotating magnetic field. Rotational unbalance is easily corrected. Precision bearings reduce this source to an acceptable value, but the magnetic problem requires special treatment. A careful study of this source of vibration revealed that a symmetrical mounting about the bearings reduced the magnetically caused vibration in the ratio of 13:1. Mechanical vibration from pumps is effectively eliminated by soft mountings and neoprene hose but the hydraulic vibration cannot, as yet, be controlled. In an electrical circuit transmitting dc. with one or more ac. components, wave traps can be used to smooth the voltage. But the frequencies from a pump, which are a few hundred cycles per second, cannot be bypassed in the same way. It is impossible to design a piston and spring that will have the necessary displacement and at the same time have the correct natural frequency.

Outboard motors have been used on the premise that both the machine and motor are independently supported on a relatively immovable floor. The equivalent is a heavy base supported on corner springs on which are mounted two stiffly sprung masses, one mass corresponding to the machine, the other to the outboard motor. The motor will have a vibrator fastened to it that produces a sinusoidal force. It is evident that an outboard drive should be used on solid massive floors only.

Typical Problems

A few examples of actual problems may be of interest:

1. An unbalanced grinding wheel ran true after dressing. Chatter was produced by the unbalanced force that caused relative motion of the wheel and the work. The only solution was to balance the wheel.

2. Unbalanced piece resulted in: (1) an eccentric bore, or (2) an elliptical bore when the support was not symmetrical elastically. Ordinarily, eccentricity or out-of-roundness will be but a fraction of a tenth. The best solution is to balance the work.

3. Failure to spark out. A workhead, reported to spark every 2¼ revolutions, was set up and found to do just that. A similar anti-friction bearing was rotated by hand. One roller made a complete revolution around the center of the bearing every 2½ revolutions of the inner race. Evidently one roller was slightly

large, causing the geometric center to rotate about the center of rotation. New bearings solved the trouble.

4. During a cylinder-grinding operation, a chatter of 240 cps. existed. Measurements showed no sizeable vibration other than 120 cps. The wheel was turning 80 rps., and this resulted in three spiral threads being formed on the wheel. Obviously, the wheel contacted the work three times per revolution. There were two possible solutions, the simplest being to replace the motor.

5. The profilometer reading of a bored sample measured 8 microinches. Calculation indicated the reading should be five. Vibration measurements showed a dominant frequency which, by elimination, was associated with the ball bearings in an idler pulley. Precision bearings were installed and the profilometer reading dropped to about five.

6. Sometimes resonant effects are achieved by chance which would be difficult to accomplish intentionally. A flycutter on a Bore-Matic produced a badly chattered surface. The quill was observed to vibrate perceptibly when idle. The excitation, which just happened to be the resonant frequency of the quill, was caused by mechanical vibration from the pump. Rubber isolation eliminated chatter.

7. A boring head with ball bearings produced an 8-microinch surface, which was satisfactory, but the appearance was not good. Measurement and calculation showed the front bearing to be the source of excitation. A better quality bearing reduced the profilometer reading to six, and the chatter marks could not be seen in ordinary light.

8. The final example is one which was not simple and which was solved by intuition. Two boring heads, mounted on a bridge, bored surfaces which were satisfactory in appearance. However, profilometer readings on the sides were three microinches greater than those on the top and bottom. A vibration analysis was made but this gave no clue to the cause. The idlers and belts were changed; the work support was stiffened; the speed was changed; the tools were changed; the table speed was changed; the heads were replaced. Though the magnitude was changed, the relative surface finishes remained the same. An attempt was then made to determine resonant effects but this yielded nothing. It was reasoned that the bridge must be different elastically in the horizontal and vertical directions and a new bridge was taken from stock having greater horizontal rigidity. This solved the problem. The difference in the two surfaces was probably caused by a component of chatter with a peak-to-hollow amplitude of 9 millionths of an inch.

These examples illustrate progress; show that a fair start has been made. It is unfortunate however, that knowledge of vibration troubles is not yet sufficient to analyze all of them nor to solve those that have been resolved into problems. Someday it may be possible to set up a network, equivalent to that used to solve electric transmission-line problems, from which a machine tool can be designed and built correctly the first try.

An abstract of a paper, "Elimination of Vibration in Machine Tools," presented at the Machine Tool Forum held at Westinghouse Electric Corporation, April 8 and 9.

All-Carbide Boring Bar

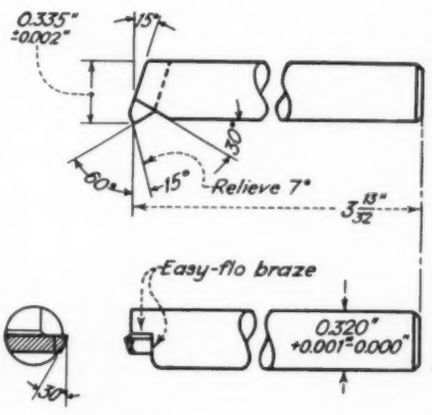
By H. E. YORK
DEVELOPMENT ENGINEER,
CARBOLOY COMPANY, INC.

Increased stiffness doubles usual length-to-bore ratio, halving time on valve guides

LACK OF STIFFNESS, or "spring," of the boring tool frequently causes trouble in precision-boring small-diameter holes. "Backing away" of the tool causes eccentricity and taper; "winding up" causes chatter.

For example, in semi-finish and finish-boring cast-iron valve guides (160-200 Brinell) for an automobile engine, it had been considered impossible to complete the final operation in one setup. Ratio of bore length to diameter (0.345 in.) was 7.3 to 1, while 4 to 1 is generally considered the maximum for steel boring bars. So these guides were bored from both ends, tending to leave a slight undercut, about 0.0002 in. deep, in the middle. The undercut was not objectionable, but double chucking was. A stiffer boring-bar material was indicated.

Cemented carbides have a modulus of elasticity of 73,000,000 psi. or more, depending on grade, as compared with 30,000,000 psi. for steel. So a number of boring bars were made from solid Carboloy 55-A, tipped with Carboloy 999, brazed on with Easy-flo. As sketched, the top of the tip was brazed to the bar—generally regarded as poor brazing practice because the bronze is in tension rather than compression during cutting. But the load in this case was so light that no trouble was experienced.



This carbide-tipped solid Carboloy precision boring bar semi-finish and finish bores long, small-diameter (0.345-in.) holes in cast-iron valve guides. Ratio of bore length to diameter is 7.3 to 1, yet holes were finished to a tolerance of 0.0002 in., kept round and straight

Cutting angles are shown. The carbide tip has a nose radius intentionally held small to prevent chatter, yet larger than would be possible if the tip were on a steel bar. The nose radius tends to wipe out feed marks, thereby improving surface finish.

Originally, the plan was to semi-finish the bore on the "in" pass, and to finish it on the "out" pass, but no suitable precision-boring machine was available. The job was therefore chucked in a small lathe, with the boring bar held in the toolpost. Feed was increased to 0.002 in. per revolution, yet gave a finish comparable with that previously obtained at 0.0003- to 0.0005-in. feed on conventional equipment. Bored holes were straight, round, concentric and within a tolerance of 0.0002 in. As a result, a precision-boring machine designed to use carbide boring bars in routine production of long, small-bore, valve guides is now being built.

Two Forms of Electric Energy

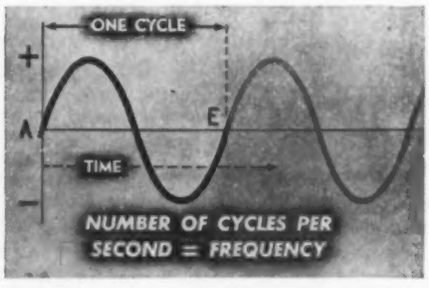
ENERGY can neither be created nor destroyed, but it can take on various forms such as mechanical, heat, electrical, and chemical, and these forms may be converted, one to the other.

Electric energy is commonly generated in one of two forms—direct current—of which your automobile generator working with a battery is a typical example, and alternating current—such as we receive from power stations.

In direct current, the electrons flow around a circuit in one direction only. An ideal example of d.c. is the current from the familiar dry cell which produces a constant, unvarying pressure, or voltage. Direct current from other sources, such as a generator, is practically constant. But there may be a small fluctuation in voltage, producing what is called a "ripple" in the value of the voltage.

For many purposes, however, we use a.c., in which the electrons flow back and forth in the circuit as the voltage changes direction. In a graph of typical a.c., called a "sine" wave, voltage reverses its direction many times per second. It swings smoothly to a maximum positive value. Then it swings smoothly down to and through zero to a maximum negative value. Then back through zero again, ready to repeat the action. From point *A* to *E* is called one cycle. The number of cycles per second is referred to as the frequency.

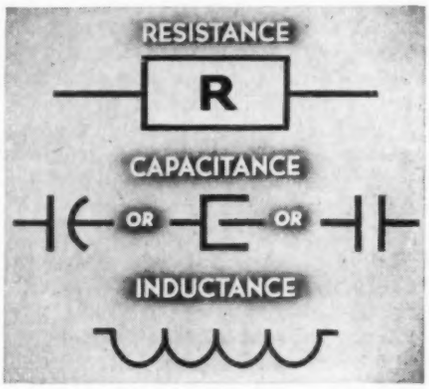
Three basic characteristics, resistance, capacitance, and inductance, are common to every electric circuit. They involve electric energy transfer, resistance by conversion to heat; capacitance and inductance by transferring electric energy to temporary storage.



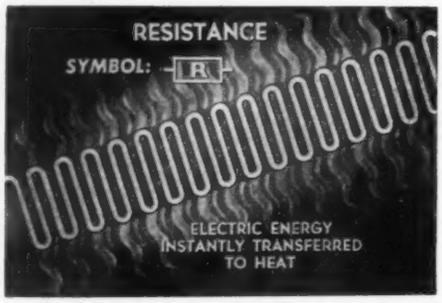
A sine wave is typical of alternating current

In resistance, electric energy is instantly transferred or converted into heat, which cannot readily be changed back to electric energy by any simple means.

We measure resistance by the ohm.



Symbols for resistance, capacitance and inductance are shown



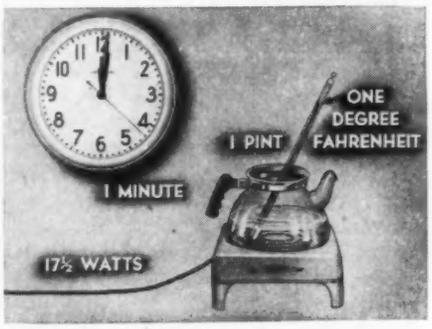
Heat generated in resistance may be thought of as the result of electrons crashing into atoms causing a disturbance among them

One ohm is the amount of resistance that will permit one ampere of current to flow through a circuit under a pressure of one volt.

While there is resistance in all conductors, a good conductor offers a minimum of obstruction to the passage of electrons. Our best conductors are copper and silver.

On the other hand, a poor conductor puts up greater resistance and electrons flow with increased difficulty. Iron, steel, and most alloys are poor conductors.

Some materials, however, which we call insulators, allow practically no electron flow. Even extremely high voltages can force only small current through them, so virtually no heat is generated. Common insulators are porcelain, mica, rubber and plastics.



This amount of energy is called a British thermal unit, equal to 252 calories

There is a definite relationship between electric energy consumed and the heat generated in resistance. For example, it always takes about seventeen and a half watts one minute to heat a pint of water 1° F.

In many cases resistance may seem a nuisance, since some energy is always lost to non-useful heat. Yet resistance has its practical applications. It is used in two ways:

(1) to produce useful heat and, (2) to control electric energy in a circuit or part of a circuit.

Practical Uses of Resistance

For producing heat we find resistance as the principle of many appliances and equipments used in our homes and industries. Electric heaters, electric coffee makers, toasters and soldering irons are typical examples.

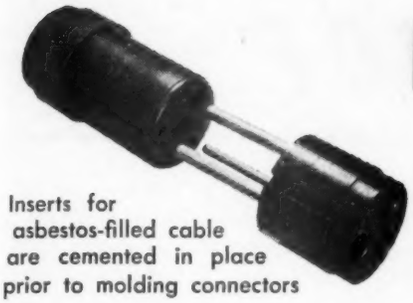
Many electronic tubes employ the heat caused by resistance to "boil" electrons out of the cathode.

We can use fixed or variable resistance, for controlling electric energy in circuits. Fixed resistance is merely a resistance of a predetermined number of ohms, used to allow conversion of a definite amount of electric energy.

A rheostat is our simplest example of variable resistance. If we want a large amount of current or electron flow, we use a small portion of the resistance. Today, however, electronic tubes are often used to perform the functions of rheostats, because of their greater flexibility and speed of operation.

Based on a sound slide film in the General Electric industrial electronics course.

Plastics Are Molded Cold, Too



Inserts for asbestos-filled cable are cemented in place prior to molding connectors

Low tool and labor costs, when heat resistance, not finish, is the criterion, can be realized with this simple process

CONVENTIONAL hot-molded plastics provide a rapid production of highly finished products. Although there are only relatively few cold molders, products are gaining a substantial market in the machine tool and other industries for parts where exceptional finish does not matter but resistance to heat is required.

The art of cold molding merely requires that a charge of plastic compound be introduced to the mold cavity, that it be compressed in a cold condition and subsequently baked under oven or infra-red heat. It is during this heating period that curing or polymerizing takes place and the product assumes its infusible shape.

The process is the most rapid method of producing plastics, in fact it can be done on a mechanical punch press at a rate of anywhere from 60 to 90 pieces a minute. Material and forming costs are low; the curing period is the major production cost. Tool cost is comparatively low because the mold cavity does not have to withstand longer periods of heat, pressure and acid reaction from the compound. Production from a cold mold runs anywhere from two to four times that of a conventional hot mold for this reason.

Molds are practically always of the positive type, and the part is raised above the cavity for easy handling. As the part is in an uncured state, resembling a preform for conventional molding, knockout pins cannot be used safely. If the part is raised above the cavity it can be easily handled without injury. However, ejection pads can be used for removing the part from the cavity, providing the pad area is large enough to prevent indentation of the part.

Because the life of a mold for the cold-molding process is long, there are more replaceable parts in the tool. These parts can be easily replaced and considerably extend the life of the unit, as the wear only comes from abrasion and pressure.

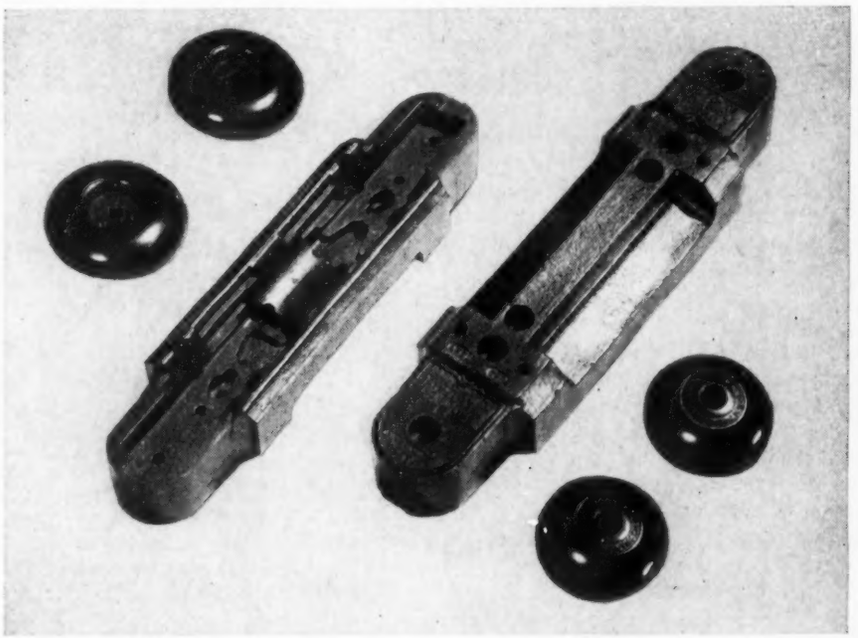
Small-lot production can be economically handled because of the low tool cost, which meets the needs of most shops requiring either electrical or control parts. In recent years, considerable gains in mechanical strength have been obtained by using a synthetic resin instead of a natural resin such as pitchblende. With a resin, which is usually phenol formaldehyde, steam channels must be placed in the mold to hold the temperature slightly above that of the room, but well below the curing temperature. This does not slow the cycle but merely leaves the resin liquid.

Asbestos is the most commonly used filler, comprising about 70 to 80% of the compound. The flow of the material is comparatively poor, and the compound must be carefully weighed and distributed throughout the cavity. Inserts can be easily loaded into the cavity, but usually require cementing or some means of rigid support because of the unequal and rapidly applied pressures.

Production is usually from single-cavity dies, or at most, two-cavity dies. On even the largest pieces, pressure need be applied no more than 5 sec. After removal from the press, the piece is subjected to oven heat, starting at 190 F. to a maximum of 425 F. Phenolic cold-molded materials usually have tensile strengths of 3,000 to 4,000 psi., flexural strengths of 6,000 to 7,000 psi. and impact strengths of 0.15 to 0.16 lb. per in. of notch. Mold shrinkage in the cold method usually runs about 0.006 to 0.008 in. per in. Phenolic resins, in liquid or powdered form, used in any specific cold-molding application must be chosen with care to achieve maximum desired qualities in the finished product. Such factors as type of equipment, pressure conditions, oven-curing facilities and product characteristics determine the resin best suited for the purpose. The resin for original compounding should have high flow and good coverage.

Cavities may be chrome-plated, but this is only done where surface finish must be good and where the compound has high adhesive qualities. Interchangeable cavities may be used in the same mold block, which is fastened to the press platen. This decreases costs and increases economy.

Photographs courtesy of Durite Plastics, Inc.



Holes may be readily cored into cold-molded parts such as these radiator valve handles and electronic fuse blocks

TALKING SHOP

Toy Gamble

RUMORS are that a surprising number of good mechanics are pulling out of safe and sane jobs to start their own plants. Among pet projects are press shops for mechanical toys, a field we've always heard was a real gamble—either a billion or a bust, depending on the success of a toy in the Christmas market. Maybe the boys welcome the chance to worry over dollars rather than tolerances, but the small-press market is pinched as a result.

Old Problem

STUDENTS of mechanics are intrigued by a railroad-car wheel, which while rotating about its center has as its actual center of rotation its line of contact with the rail—a center which changes continuously. Now Pullman-Standard points out that the actual area of contact between wheel and rail can be covered by a thin dime.

Own Way

ONE UNUSUAL, and commendatory thing we noticed about the recent Tool Show was the number of tool engineers who paid their own expenses to come. Seems like a good many men still believe there are things to learn.

Your Shop

SPURRED by reader reaction to his cartoon of several months back, O. Fluharty is developing a series. We bring you number 2 on "Our Shop" herewith. You'll find 'em very laughable—and very reminiscent of shops you've seen or worked in. Posting is permitted.

Fluid Flywheels Loom

HYDRAULIC COUPLINGS interest all auto makers these days. Several parts makers are reported hard at researching so production can be begun.

Daily Newsfoil

AMONG NEW packaging is thin aluminum foil, replacing present 3-layer packaging for frozen foods. High conductivity of aluminum cuts freezing time 30 to 50%, according to Reynolds Metals, cuts out air, light and moisture transmission. Labels are printed directly on the foil. There may come a time when we'll read daily newsfoils and have crackle-proof winterizing under our mattress.

Technical Treasure Hunt

THE OFFICE of the Publication Board, Dept. of Commerce, Washington 25, D. C., and the War Dept. are asking Industry's advice. They've got masses of German technical documents and don't know which to microfilm to send over here for Industry's use. Further, they'd like ideas of where other documents may be found, technical personnel to examine 'em—even will entertain suggestions for inspecting delegations. Here's your chance for film, fortune or ferreting.

Spring Connectors

REMEMBER those coiled cords on your wife's — excuse us, maid's — electric iron? Well, Kellogg Switchboard has heavied 'em up, coated 'em with neoprene and supplies 'em for electrical control on machine heads. The Bullard vertical turret lathe now has two, for example, connecting microswitches on machine heads with fixed solenoids. No tangled wires and simpler hookup.

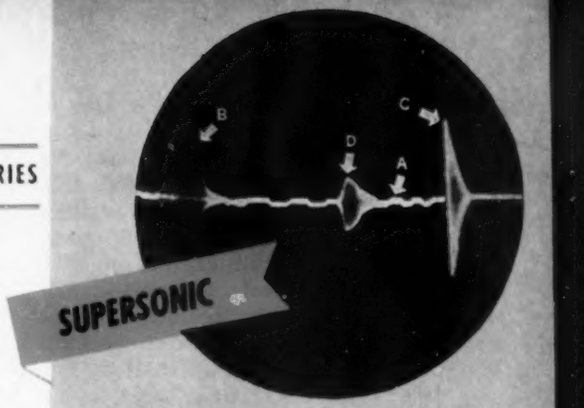
OUR SHOP...2 — *Quality Control Dept.*

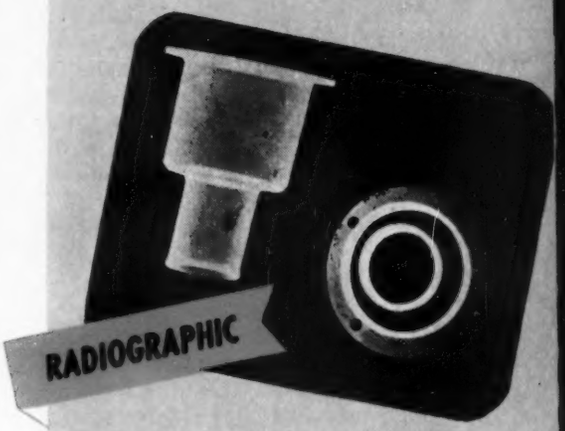
Non-destructive TESTING METHODS

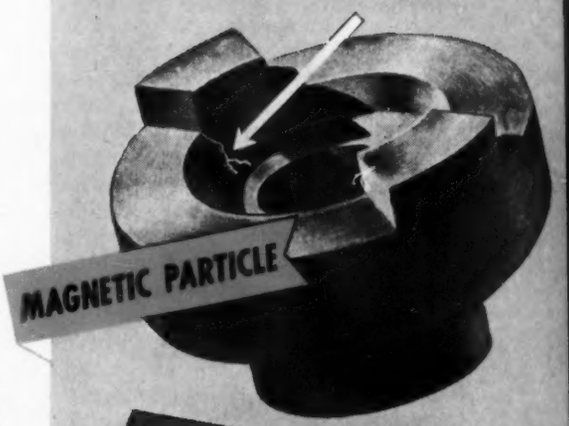
BY RUPERT LE GRAND

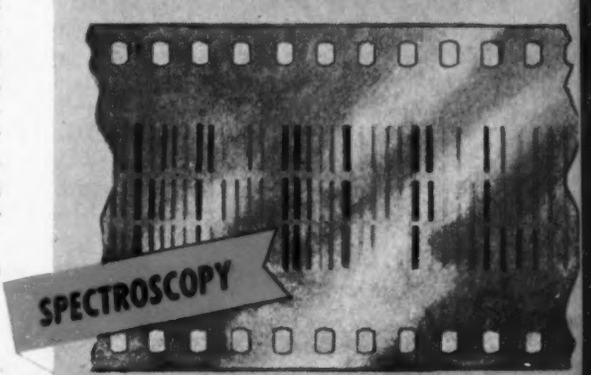
Associate Editor

"Non-destructive testing," a high-sounding phrase, means just this: methods for separating sound parts from defective pieces without impairing their usefulness. Primarily, these non-destructive testing methods aid in quality control of manufacturing processes, but we are finding many uses for them in routine, or spot, inspection as a check on both products and process. To sum up: Scientific testing equipment (designed for shop usage in many cases) cuts down the percentage of rejections and the number of service failures. In succeeding pages, familiar and new types (see "indications" at right) are described, utilizing latest data from producers and users.









FOUNDRIES, forge shops and machine shops do not use non-destructive tests for the fun of it. Tests cost money: a lot of good parts can be scrapped if testing is not done intelligently. But the use of non-destructive testing grows apace. People were forced into it during the war. They are holding onto the testing equipment then purchased, and they are asking makers of testing equipment for laboratory tests and recommendations on an astonishing array of new products and on new materials basic to new products.

What is bringing about all this interest? A few months ago industry finished a big job for Uncle Sam. Plant managers and engineers had bumped into many a smart development. They saw that manufacturing processes, also products, were becoming more technical. Now they are being asked, or see the need, to do more work with metals and materials which did not enjoy an important place in the pre-war world.

But somehow the processing of these materials goes haywire. Rejections are excessive. The customer grows angry over delays in delivery. Finally, the contract is cancelled and the business goes to a competitor who seems able to make the grade.

At this point, the disappointed manufacturer is ripe for any cure-all. Perhaps he hears that the Mighty Widgit Company in the next town put in an X-ray machine with astonishing results. The story might go like this: machining cost per piece was $125, machining losses on pieces found to contain blowholes, $40,000 a year. Foundry rejections were high. However, the X-ray machine aided development of foundry methods that did away with rejections in the machine shop, thereby saving the $40,000 outright, and machining cost was cut to $70 per piece. Should the disappointed manufacturer rush out to buy an X-ray machine or should he analyze his requirements, which might well include X-ray and possibly other

tests of a totally different character?

For it is a fact that non-destructive tests are not in cut-throat competition —they tend to supplement each other. And of course there are all kinds of non-destructive tests. The well-known spark test is highly regarded by competent people as a means of checking stray bars of the wrong analysis, but reasons can be found why other methods are better under different shop and product conditions. Physical laws can be drawn upon to make up tests *ad infinitum*. On the whole, however, it is a lot safer from the standpoint of reliability and cost, to use methods which have stood the acid test of commercial exploitation.

Establish Tolerances

In setting up a program for non-destructive testing, thought must be given to the basic data which such tests will be called upon to give. There is no perfect part. All pieces have irregularities: these are defects only if their size, shape, kind or location likely will induce failure under the expected or likely service stress. So it is necessary to establish tolerances for irregularities. And these tolerances can only be set up through load tests, destructive tests, non-destructive tests, and sectioning, or cutting up, the parts, to see which irregularities can be tolerated. It is simply no good to say that a gas-turbine blank will probaby fly apart because a certain test reveals minute discontinuities. The safer and more scientific thing is to cut up ten pieces, and *know* which irregularities are of no importance and which are truly defects.

Of course, technically trained personnel are needed to set up tolerances for irregularities, to assist with process development, to utilize the equipment with respect to production research. But operators with an interest in new things can be trained to handle routine checks in a few hours, days or weeks, as the case may be.

In short, non-destructive testing is basic in an up-to-date manufacturing program for products involving a degree of technical know-how. The testing operation can be carried out right in a production line or as part of batch-type manufacturing. Equipment and handling methods have been developed to make such usage feasible. Or the testing installation may be installed in a laboratory and the work scheduled as part of the usual routing procedure. This special section covers a number of proved non-destructive testing methods.

Man's eyes are limited to surface examination of non-transparent materials. If he wishes to search for hidden flaws in metals or plastics, a more penetrating form of energy than light must be used. X-rays will pass through several inches of steel to reveal flaws upon a radiographic film or a fluorescent screen. Or details of a substance's analysis or prior treatment can be learned from X-ray diffraction. So in process development and quality control, five types of radiographic inspection are utilized: X-ray, gamma ray, fluoroscopy, photo-fluoroscopy and X-ray diffraction. Their principle of operation, uses, advantages and limitations are discussed in detail.

Radiographic Inspection

DETERMINES ACCEPTABILITY OF MANY PRODUCTS

X-RAY RADIOGRAPHY

What Radiographs Are—X-rays are an invisible form of radiant energy with wavelengths approximately 1/10,000 that of visible light. The shortness of the rays permits them to penetrate opaque materials; the depth of penetration depending upon the power of the X-ray beam. If this power is adequate to pass entirely through an object, and sufficient time is allowed, special film placed on the opposite side will be exposed. The developed negative, or radiograph, then serves as a shadow picture, wherein changes in density or thickness are revealed by light and dark areas. Voids, cracks and holes appear as dark areas, because they permit readier passage of the X-rays to the film.

Fields of Use—There are innumerable applications of X-ray in industry. The most important are:

1. Welds—(a) to aid in development of techniques, (b) to serve as records where X-ray inspection is mandatory, as in pressure vessels, (c) to provide a spot check of workmanship of less-critical material and (d) to record the quality of repaired sections.

2. Castings—(a) to detect porosity, piping, gas cavities, blowholes, shrinkage and stress cracks, inclusions and misruns as a control measure in development of products and foundry techniques for the purpose of avoiding rejections and machining losses, and controlling metal put into the casting (b) to demonstrate that critical castings are free of defects in important sections, (c) to check the quality of welded repairs.

3. Forgings—(a) to locate bursts and other defects during development of forging techniques, (b) to reject forgings that do not meet critical acceptance requirements, (c) to reveal irregularities that would be cause for rejection at final machining; for example, blowholes at the finished surfaces of dies or molds.

4. Plastic parts—(a) to aid in development of molding practice, especially where the location of inserts is critical, and (b) to determine soundness of plastic parts, particularly those subject to stiff requirements for electrical or other properties.

5. Assemblies—(a) to check final assemblies, where internal parts cannot be viewed; for example, electrical switches, meters, also timing mechanisms, (b) to show that adequate fusion exists in soldered or brazed joints, (c) to measure dimensions of hidden parts.

Future uses are: (1) inspection of symmetrical material by its X-ray absorption, using ionization instruments, the Geiger-Muller counter, or fluorescent screens in conjunction with photoelectric effect, and (2) gaging of strip material in rolling mills without physical contact by measuring variations in transmission of X-rays through the moving strip.

Materials Examined—Current applications of X-ray to examination of materials, in order of importance, are: (1) light alloys, (2) steel, (3) other metals, and (4) plastics.

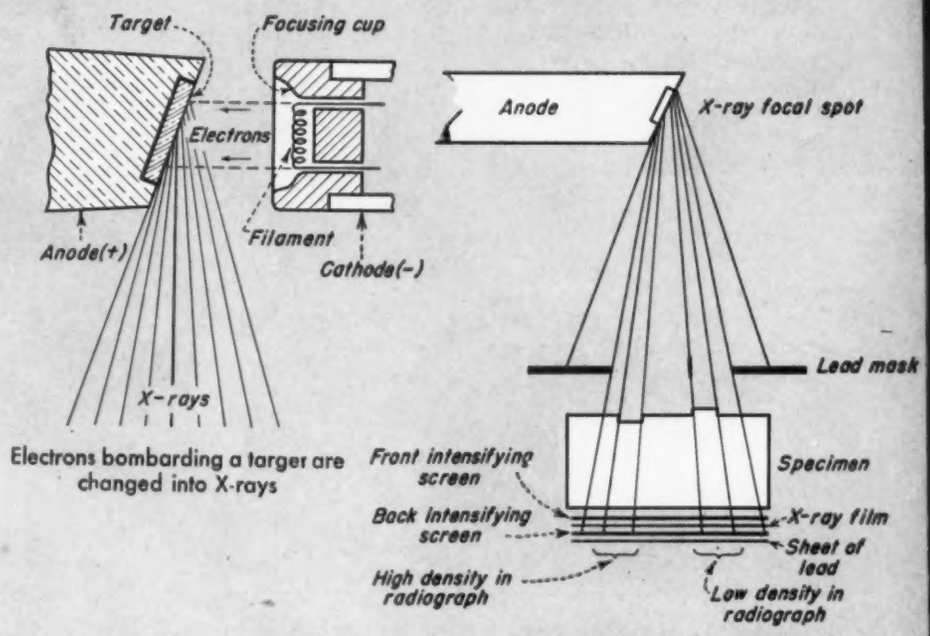
Aluminum and magnesium lend themselves particularly well to X-ray examination, because of a low atomic weight and more ease of penetration. Thus, smaller cheaper equipment can be used to study these metals, which are subject to many faults because of fast cooling rate, namely, (1) gross porosity, (2) stress cracks, particularly in magnesium, (3) shrinkage cracks, (4) ordinary porosity that comes about through improper degassing of metal, whether rolled or cast. In the opinion of X-ray specialists, up to 80% of scrap castings, forgings and die castings in aluminum and magnesium may be avoided by judicious use of X-ray in research upon processes and in sampling checks on production pieces.

Sensitivity—Under careful control, cavities as small as ½ to 1% of the metal thickness will be revealed on the radiograph. However, a sensitivity of 2% is much easier to obtain and is sufficient to meet the requirements of the A.S.M.E. Boiler Code.

Equipment Available—The field of X-ray radiography has been greatly broadened by the recent development of low- and high-voltage equipment. As a consequence, almost any conceivable problem can now be handled, and in many materials in different thicknesses. The operating voltage range of representative equipment is said to be:

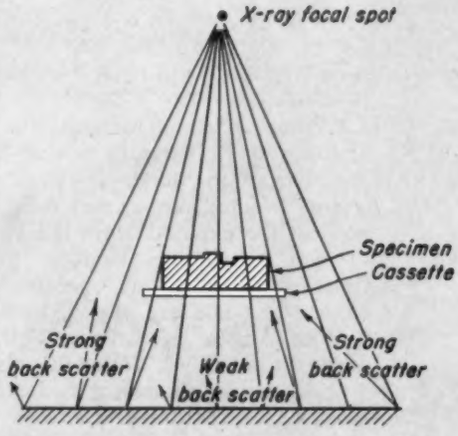
3,000 to 50,000 volts—for thin sections of aluminum and magnesium, also plastics, wood, leather and other substances of relatively low X-ray absorption. Equipment in this range is especially suitable for the examina-

PRINCIPLES OF X-RAY RADIOGRAPHY

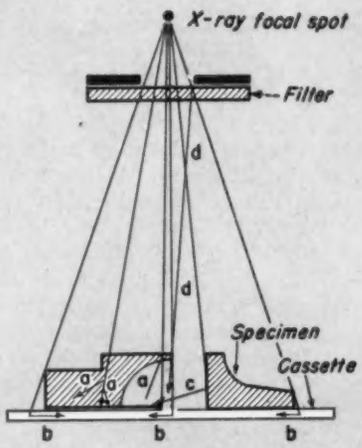


Electrons bombarding a target are changed into X-rays

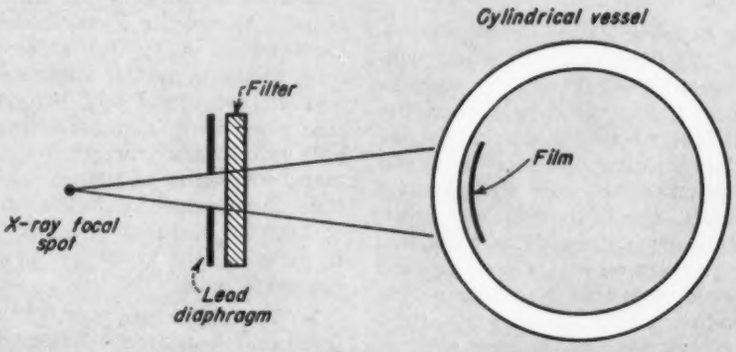
A radiograph is a shadow picture of an object, with dark regions representing more penetratable parts or voids



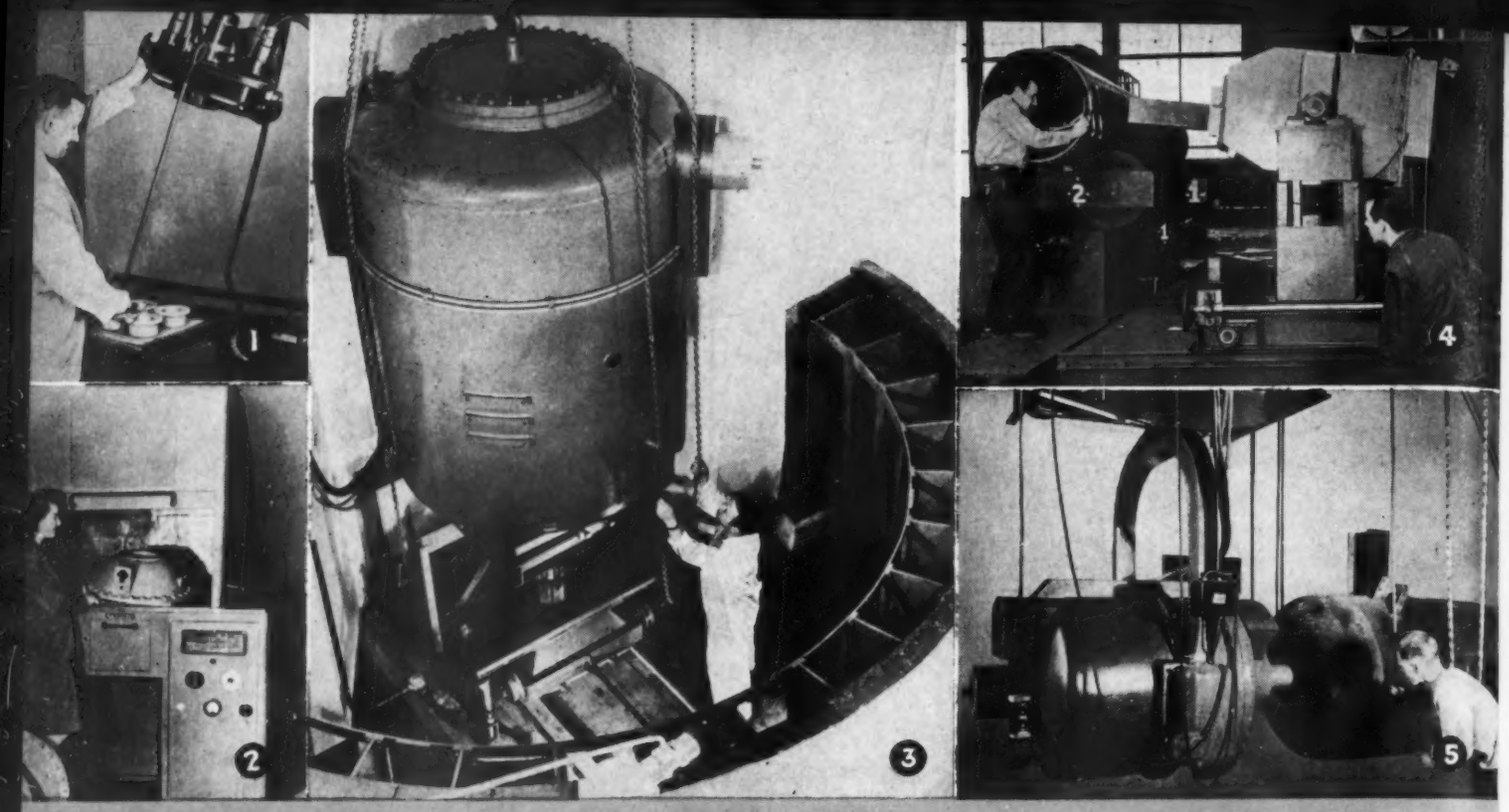
Backscattered radiation from floor or wall damages the picture, is avoided by using lead behind the film cassette



Other sources of scattered radiation: (a) by transmission; (b) from cassette; (c) reflection scatter; (d) from filter



A suitable curved cassette, or film holder, is better than a flat one, because the film should be close to the object



1—Operator uses tape to measure focal-film distance when setting up 140,000-volt unit for small castings. 2—Closed-type unit has fluorescent viewing screen as well as means of exposing X-ray film. 3—An operator was not present when this 2,000,000-volt machine "shot" large shell in turntable compartments. 4—Weld segments are examined with 400,000-volt machine. 5—The 1,000,000-volt unit handles a complete circumferential weld in one exposure

tion of spot welds in lapped aluminum-alloy sheet.

30,000 to 150,000 volts— for heavier sections in light-alloy castings: to 4 in. in aluminum and 5 to 6 in. in magnesium, depending on composition.

60,000-250,000 volts — for greater thicknesses in light alloys and steel in thin sections, namely 1½ to 1¾ in. Penetration in the copper alloys is about 0.7 that of steel.

400,000 volts—for examination of cast and rolled steel of 2 to 2½ in. thickness.

1,000,000 volts—for radiographing steel 4½ to 5 in. thick; also 6 to 7 in. thick with special techniques.

2,000,000 volts—for examining steel 8 to 12 in. thick, using special techniques and time.

The Betatron—This electron accelerator has been built in 100,000,000-volt capacity for physics research. In its present stage of development the Betatron has little more value for industrial radiography than the 2,000 kv. equipment, because the quantity of emitted X-rays is small. Of course, the rays are extremely penetrating. Possibly equipment rated around 10,000,000 volts will prove ample for any industrial purpose but it has not been developed.

X-ray equipment may be classified roughly into three types:

1. That which is designed for examining *small* parts in a lead-lined chamber with doors opening and closing to admit unexposed parts and to eject the exposed. Here the operator can remain in attendance at all times, since the X-ray operates only when the doors are closed, thus affording ample protection. Voltages range up to 250,000. Under this classification come fluoroscopic installations, which require that an operator view parts as they move through the machine on a belt-line. Besides the usual cabinet shielding of lead, the glass through which the operator views the work is chemically combined with lead.

2. That designed for *medium*-sized objects, where the X-ray machine is installed in a special room whose lead shielding and/or concrete walls and ceiling completely protect outside personnel from radiation. Suitable interlocks insure that the operator is never in the room while the tube is operating. Voltages range up to 2,000,000 and may go much higher, if certain new types of equipment are perfected.

3. That designed for objects so *large and heavy* or difficult to move from site that the equipment must be mobile so that it can be brought to the work. Voltages up to 400,000 have been employed. Here, reliance can be placed on a combination of portable lead screens, distance of personnel, and cone extensions from the tube for protection from radiation. These units may be mounted on small trucks or rail cars. Application is widespread for welded and cast structures.

All modern X-ray equipment now available is of the shockproof type, so that no hazard exists from an electrical standpoint.

Limitations—Deep-seated discontinuities are not revealed by radiographic methods unless the correct angle for any particular discontinuity is fortuitously chosen.

Laminations are not easily discovered with X-ray. An indication may be present on the film, but it is usually not sufficiently detailed in character and in relation to the surrounding material.

Workers must observe necessary protective precautions. A good reference is the handbook HB 20 "X-ray Protection," prepared by the National Bureau of Standards and sold by the Superintendent of Documents, Washington, for 10 cents.

GAMMA-RAY INSPECTION

Radium salts emit gamma rays, which are similar to X-rays but have shorter wavelength, hence greater penetrating power. However, the intensity of radiation is less than is obtainable from man-made equipment, so longer exposure times are required.

Fields of Use—Capsules containing 25 to 500 milligrams of radium salts are used for making radiographs of large castings. To inspect a large steam-turbine housing, for example, perhaps 100 to 200 films will be taped to the outside and one or more capsules are located at strategic points within the casting. Better results will be obtained than with a right-angle attachment on a high-powered X-ray machine, because the gamma radiation is uniform in intensity in all directions. Or if a dozen or more large brackets are to be inspected, they can be set up in a circle and the capsule placed in the center. In the examples mentioned, considerable manhours may be saved for setup, teardown and exposure as compared with making many X-ray negatives in sequence. Therefore, exposures requiring overnight or a weekend are justified under the proper conditions.

A growing field of use for gamma-ray inspection is the examination of structural welds, especially in shipbuilding. Here welds are examined as part of the quality-control program, and radiographs are made of sections after defects have been chipped out and again after the weld is repaired. The over-all cost of radiography here is said to be 25 to 50% cheaper than trepanning, to provide plugs or test coupons, and 100 times as much weld area is actually examined when 6x18-in. films are used.

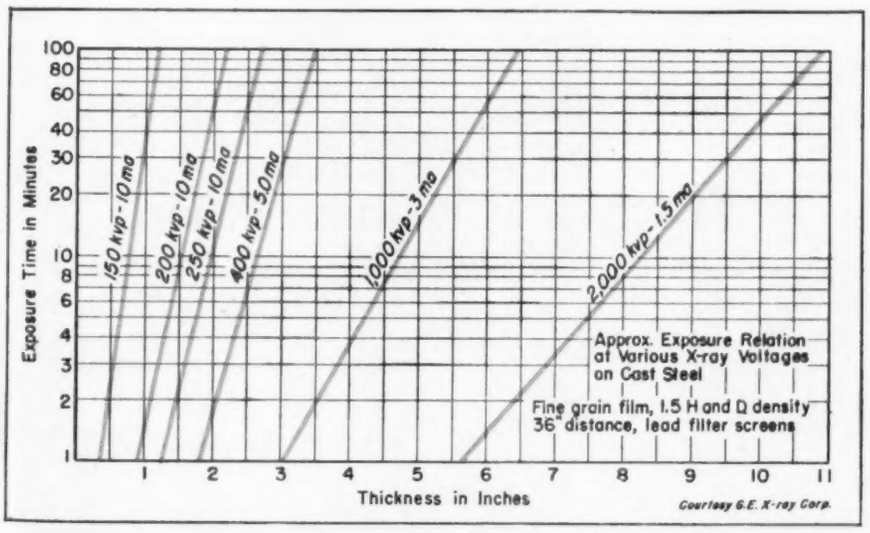
Sensitivity—In steel less than 1 in. thick, the gamma-ray method is not as sensitive to small defects as the X-ray procedure. In thickness from 2 to 4 in. the two methods are about equal. In general, the sensitivity of the method lies between 2 and 5%.

General Advantages—Almost any thickness of metal can be penetrated by gamma rays, given sufficient time. Radium capsules are easily transported within the shop or to examination points in the field. Setups can be made according to the operator's convenience; no costly equipment is kept out of use. Radium can be rented for various periods; it provides a means of getting started in radiography at small expense. Gamma rays do not scatter as much as X-rays, hence filters are required less often.

Limitations—The inspector who is only familiar with reading X-ray negatives can underestimate the seriousness of defects revealed by gamma-ray exposures, because the latter do not have as much contrast.

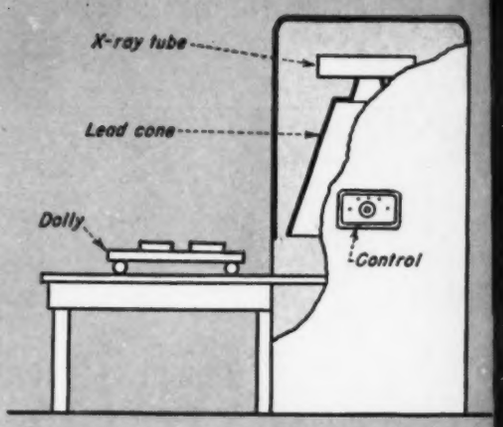
RADIOGRAPHIC FILM

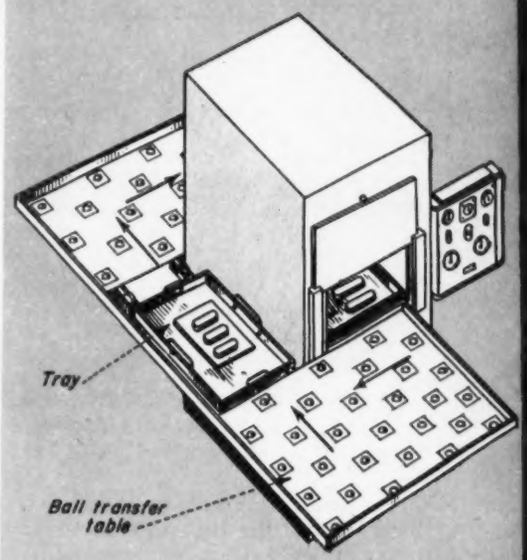
Special films for industrial radiography were not offered commercially until 1939. Since then, films in several degrees of speed and contrast have been developed, and steady improvement has been made in film characteristics. Popular sizes for checking castings and forgings are:

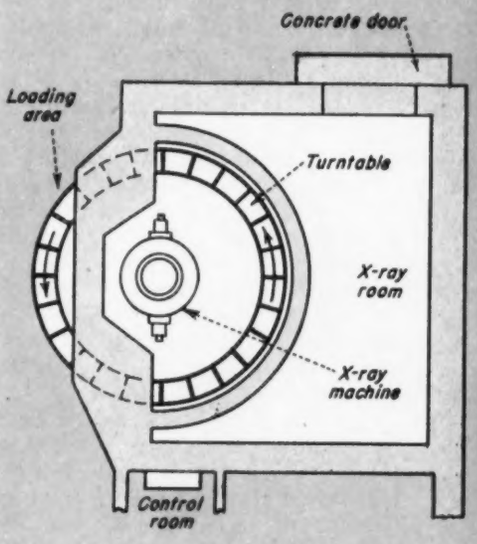


X-ray penetration depends upon the voltage of the equipment. To X-ray 5 in. of steel, either a one- or two-million volt unit must be used

WORK HANDLING METHODS



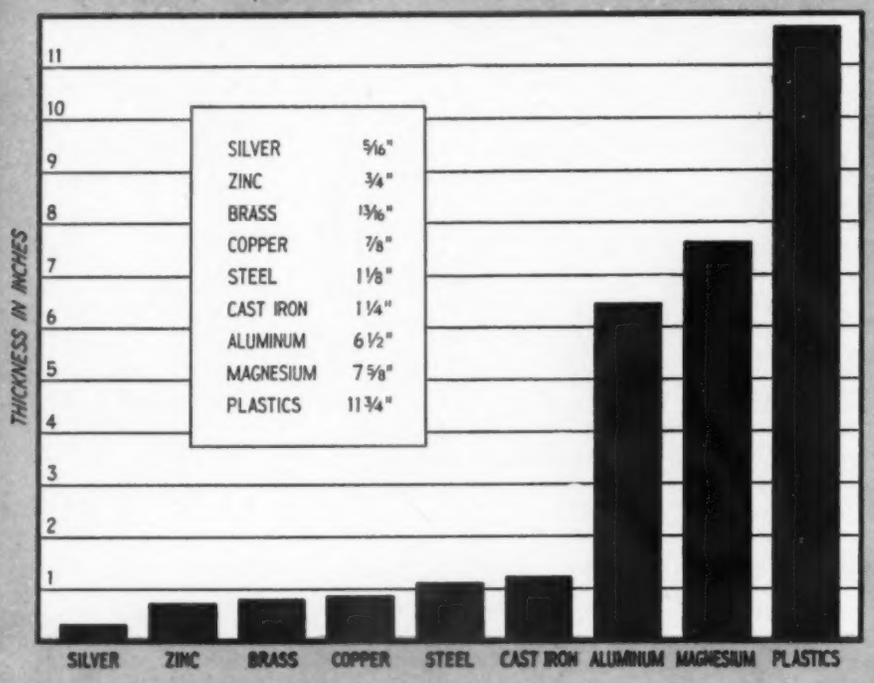




Well-known work handling principles apply to X-ray operations. Closed-type equipment can be arranged with feed tables as sketched at top and center or with loop conveyors. The installation at bottom (shown in a plan view) was used to X-ray loaded shell at an ordnance plant

RADIOGRAPHIC PENETRATION IN INCHES

This chart gives the X-ray penetration available with a 150,000-volt machine. A 75,000-volt unit handles about one-half these thicknesses



14x17, 8x10, 10x12, and 5x7 in., while the preferred narrow sizes for weld inspection are 4x10, 3½x17, and 7x17 in.

The sensitive emulsion (applied on both sides of the base to take advantage of the penetration of x-radiation) used to coat X-ray film is radically different from the emulsions applied to films used in other types of photography. Some of these films are intended for direct exposure to X-radiation; others are of the "screen" type, in that they are used with calcium-tungstate intensifying screens. The screens fluoresce when excited by X-rays, and the blue light emitted rapidly produces density in the recording film. The use of fluorescent screens shortens exposure time and increases the maximum metal thickness which a given X-ray generator can economically penetrate.

Since an X-ray negative is a shadow picture of an object, it follows that light and dark areas in the film correspond to changes in density. Regions of lesser density, such as those containing porosity, blowholes, machined or cored pockets or holes, appear dark on the negative. Sections of greater thickness or density appear light. As the object must be accepted "as is," suitable sensitivity in examination is obtained by proper operation of the X-ray equipment or the radium-capsule setup, and selection of the suitable film.

The desired characteristic in a radiograph may best be secured by proper regard for all technic factors which benefit ultimate detail visibility. Some of these factors are influenced both by the choice of film and processing methods and by the geometry and mechanics of the exposure method: (1) Subject contrast, (2) Film contrast, (3) Geometrical factors and (4) Graininess factors.

The above factors may be broadly outlined thus:

Subject contrast is the film-density difference produced by variations in the specimen thickness or density and is influenced by the radiation quality and reduction of scattered radiation.

Film contrast is the film-density difference produced by the various radiation intensities transmitted by the subject regardless of its nature. Film contrast is influenced by the choice of film, development time, film density and activity of developer.

Geometrical factors contribute or detract from radiographic quality very much the same as would exist in recording the shadow of a card placed in a beam of light. Radiation source should be small, source-to-subject distance large, subject to film distance small, consistent with economy of exposure time.

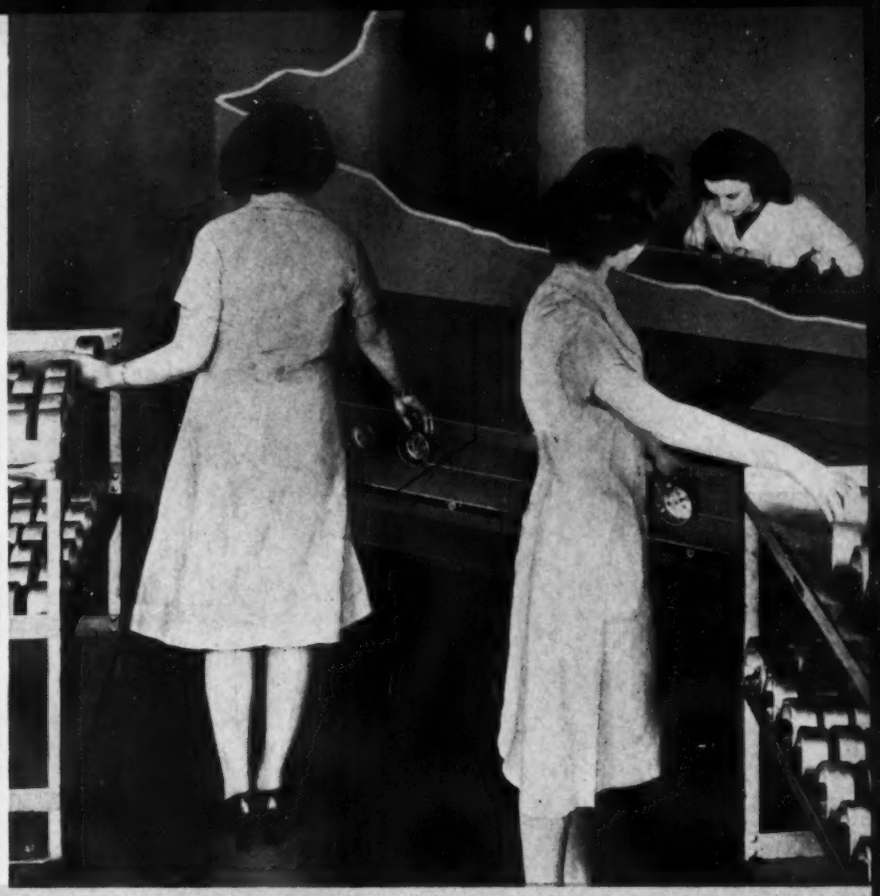
Graininess factors are affected by the choice of film, type of screens and radiation quality. For maximum detail visibility, all conditions should tend toward reducing graininess in the finished radiograph but, here again, the economy of exposure time must be considered, as reduction in graininess usually is accompanied by increased exposure time.

Fluoroscopic Inspection

What It Is—If X-rays that have passed through an object are allowed to fall upon a fluorescent screen, instead of an X-ray film, the observer can view the shadow pattern directly. Obviously this practice saves the time and bother of making an exposure and then developing and drying the film. However, except in the case of the new photo-fluorographic technique, no inspection record is available. Fluoroscopy is a relatively rapid operation.

Fields of Use—Fluoroscopic machines are of the closed variety (to be shock-proof and ray-proof) and are made in sizes up to about 160,000 volts. Thus, they are particularly suited to examination of the light

By incorporating a camera in a fluoroscopic unit, it is now possible to make a record for all parts examined and at less cost than by X-ray



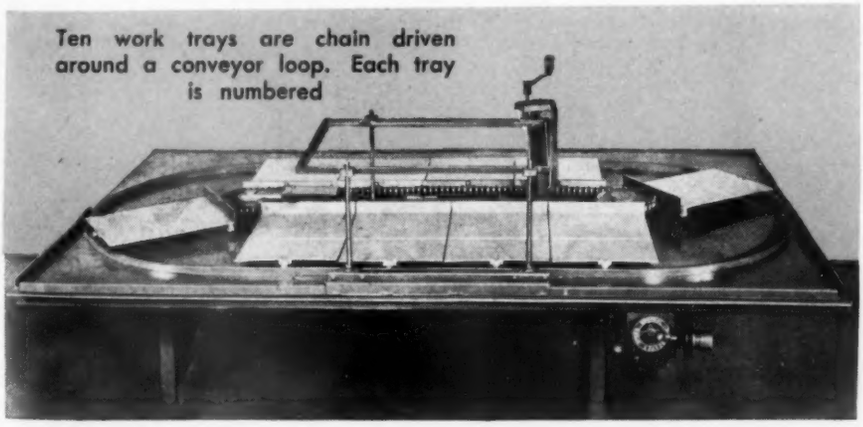
High-speed viewing of light-alloy and plastic parts is done with this conveyorized fluoroscopic machine, which uses two girls for loading and unloading and one in light-proof viewing booth at rear

alloys, diecastings and plastics for cavities and inclusions. With the new high-brightness, rotational, short-distance technique, more faults can be discovered than is the case with X-ray.

The second great industrial application is to check the correctness of assembly of finished articles. For example, a meter manufacurer had used an all-plastic spindle, later changed to a plastic spindle with a metal insert. But an order came in for several thousand meters with the all-plastic spindle. What to do? The spindles had been assembled indiscriminately into meters, which were boxed and in the shipping room. To comply with the order meant opening the boxes and dismantling the meters if a conveyorized fluoroscopic machine had not been available.

Sensitivity—The eye cannot distinguish minute differences in shadow intensity as well as a film. Hence irregularities must be at least 5 to 15% of the material thickness in order to be seen. Experts may find faults as small as 4%.

Equipment Available — Several kinds of equipment are available:



Ten work trays are chain driven around a conveyor loop. Each tray is numbered

1. The dual-purpose machine. This will take an X-ray or permit fluoroscopic examination of the object. The latter operation may be done first for two reasons: (a) to search for flaws, and (b) position the object satisfactorily for an X-ray.

2. A tunnel-type machine with an elliptical conveyor. One operator in a light-proof inclosure views the fluorescent screen, sees images of the pieces passing on a belt conveyor, uses suitable means to reject defective parts. Two helpers load and unload material at stations on the opposite side of the equipment.

3. Through-feed belt conveyor model with two operators on opposite sides. This equipment permitted 18 rocket bodies to be examined per minute for faulty assembly of charges, firing mechanisms and other internal items.

4. High-brightness, work-rotating cabinet model. The tube can be moved to view the pieces at various angles. This machine is suited to examination of castings produced against strict specifications.

5. The new photo-fluorographic technique mounts a 70-mm. camera in the base to take photographs of the part image on a fluorescent screen. This process provides a record, re-

duces film cost, the negative can easily be projected upon a screen for study, and gives maximum sensitivity for a fluoroscopic processs—about 3%, as compared with a routine 2% for X-ray, and an exceptional 4% for ordinary fluoroscopy.

Advantages and Limitations—These may be stated for two types of fluoroscopic examination:

High-Brightness Fluoroscopy

Advantages:

1. Low operating cost.
2. Fast operation.
3. No handling problem.
4. More faults can be seen than with ordinary X-ray or ordinary fluoroscopy.

Disadvantages:

1. Does not have maximum sensitivity.
2. There is no record.
3. Subdued light is required.

Photo-Fluorographic Process

Advantages:

1. High Speed.
2. Provides film record.
3. Film costs lower than X-ray.
4. More sensitive than ordinary fluoroscopy.
5. Uses 70 mm. film which files in small space.

Disadvantages:

1. Not as sensitive as X-ray.
2. Requires an elaborate camera.
3. Not as fast as ordinary fluoroscopy.
4. Workpiece can not be processed further until the film is developed and defective material is culled. However, this is no particular hardship if there is plenty of space on conveyors or pallets.

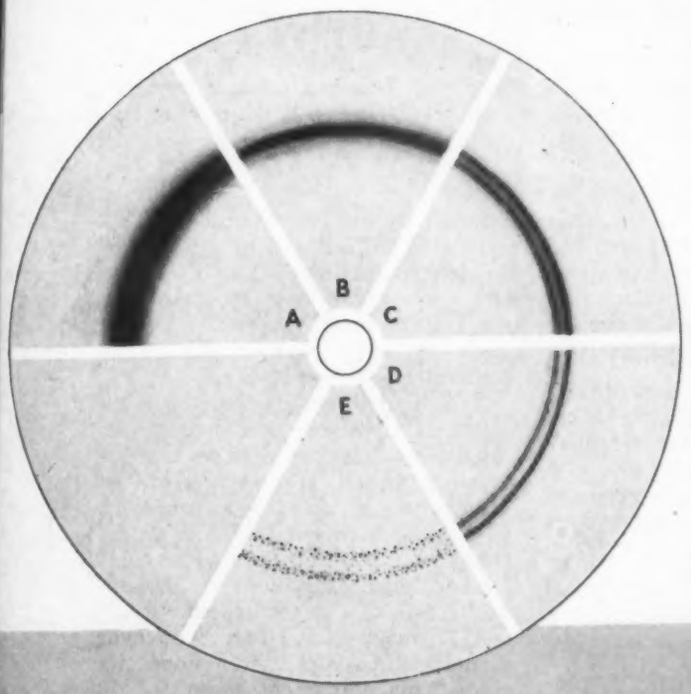
Cost—Commercial laboratories may charge approximately $20 per hour for fluoroscopic examination of production parts. Under plant conditions, the cost might drop to $15 per hour. However, the inspection cost piece is often very small. For example, a 2 x 2 x 3-in. light-alloy casting was examined at a cost of three mils per piece, using a conveyorized installation.

X-RAY DIFFRACTION

What It Is—The nature and behavior of most substances depends upon the arrangement of atoms and molecules in the crystalline structure. This is true whether the material is a deep-drawing steel, a bearing material, or a tempered steel spring. Every substance, and this applies to the various conditions of that substance, such as rolled, forged or heat-treated, has a distinct atomic arrangement which determines its properties. Among these properties is the diffractive effect produced by X-radiation. Thus, if a beam of X-rays is passed through a crystal, the beam will be bent, or redirected, in a series of emergent rays whose separation and intensities are characteristic of the material. By employing radiographic film, a record is obtained of the location and intensity of the diffracted rays. These form a "fingerprint" of the substance, because no two substances have been found to produce identical diffraction patterns.

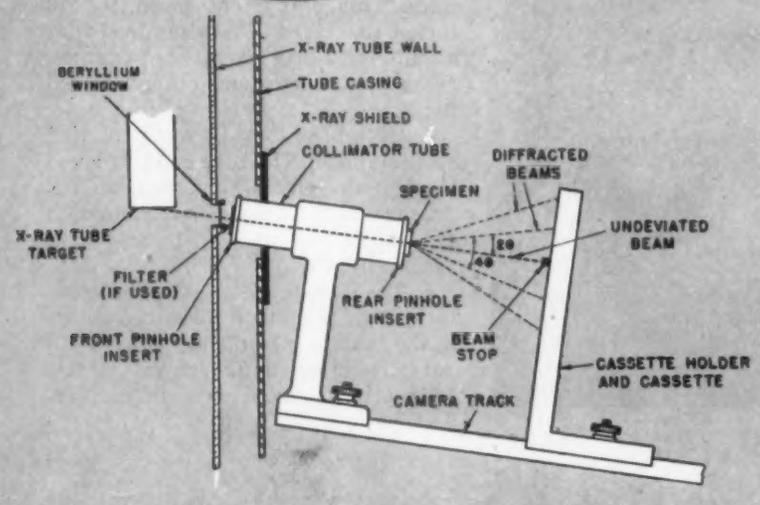
Fields of Use—Before the war, X-ray diffraction equipment was a little-known research tool. During the war many practical uses were found for it. At present, it is understood that X-ray diffraction is the most powerful tool available to industry for predicting the behavior of substances when subjected to various treatments and also of identifying what has happened to the substance up to the time of making the diffraction test.

There are two broad uses for X-ray diffraction: (a) as a laboratory tool in the hands of a trained specialist working on problems of production research or product research, or both, and (b) as a routine inspection tool

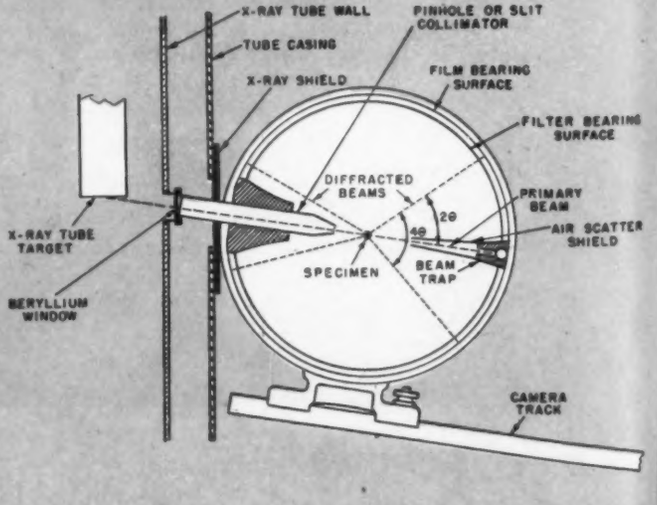


This composite photograph shows how X-ray diffraction studies reveal states of materials: *A*—steel as hardened; *B*—under tempered; *C*—optimum temper; *D*—over tempered; *E*—annealed

Three Types of Cameras for



PIN-HOLE CAMERA



POWDER CAMERA

in the hands of an operator making repetitive checks on the analysis or condition of a material.

In the first category, applications might be: (1) to find the preferred orientation of crystals in metals used for such operations as deep drawing, and (2) to work up specifications for new materials: (a) new aluminum alloys based on the mechanism of age hardening, (b) to identify the true state of materials; for example: to show that lead is not in "solution" in arsenical copper-lead bearings but rather so finely dispersed that it can not be seen by ordinary metallographic processes, and that the real problem is proper dispersion.

In the field of production control and materials checking, X-ray diffraction has numerous uses. The X-ray diffraction pattern of samples can be compared with standards, to realize the following objectives: (1) to discover whether a steel has been adequately annealed for machining, (2) to obtain a favorable anneal for deep drawing, (3) to determine quality of casehardening, (4) to give a quick and exact identification of a material and its prior processing. In regard to the last item, one of the latest applications is to check sintered carbides used for cutting tools. A certain large manufacturer received a large quantity of carbide that had to be scrapped. To avoid arguments with suppliers, future incoming shipments may be checked by X-ray diffraction.

Difficulties in machining may often be traced to the exact cause through the ability of X-ray diffraction to reveal what has happened to a material. For example, when using high-sulphur screw stock, one manufacturer found that certain bars gave trouble although there was little difference in their hardness and that of bars which machined satisfactorily. X-ray diffraction tests indicated that the unsatisfactory bars had been overheated in the furnace, and investigation of the furnace revealed the existence of hot spots.

Equipment—Three basic types of X-ray diffraction cameras are used:

Pinhole Camera—A beam of X-rays is passed through a thin specimen, and the diffracted rays impinge upon a 5 x 7 in., or smaller, film, which is mounted on a vertical holder. The X-rays are forced to pass through collimator tube fitted with pinholes or slits, so that the scattered beams will be resolved.

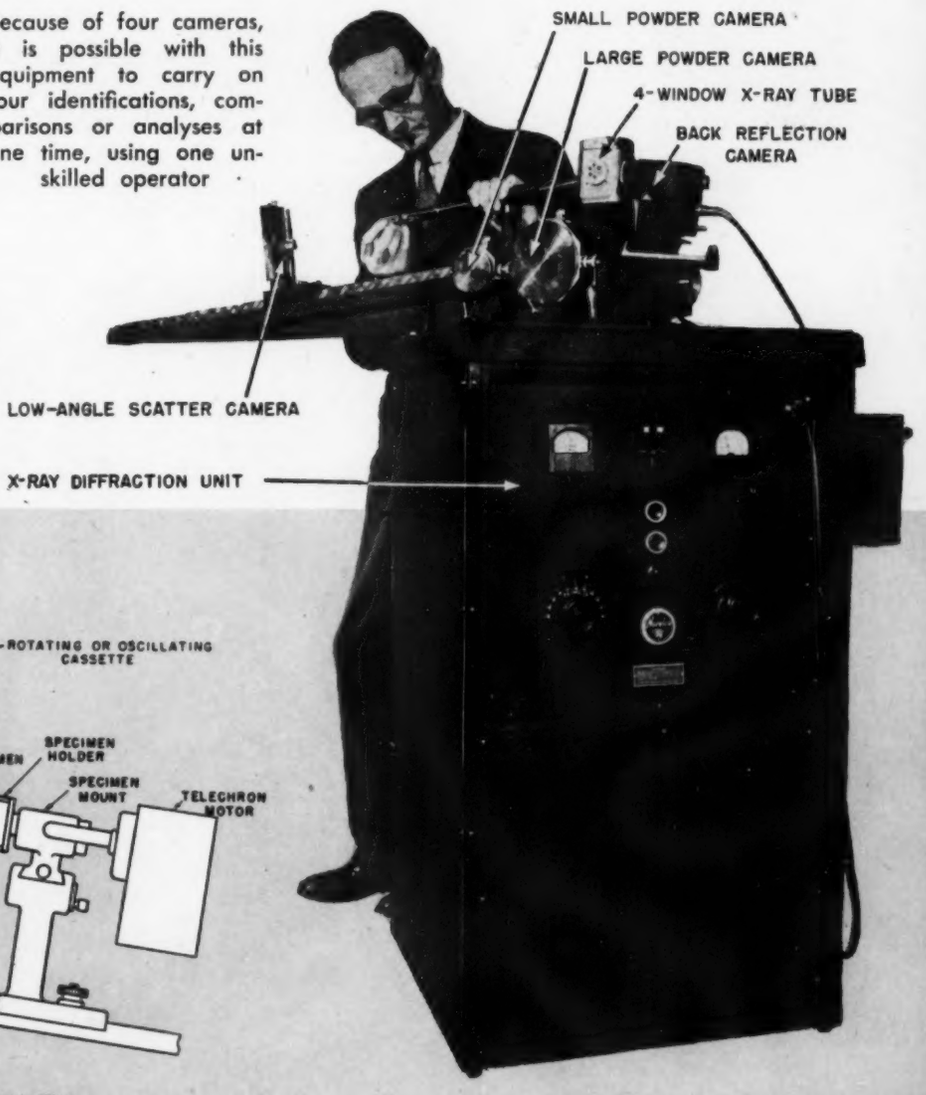
Powder Camera—A small amount of the sample is powdered and mounted at the center of a drum. Monochromatic X-rays are directed upon the powder sample by means of a collimator and are diffracted. A strip of film, usually about 2 x 16 in., is wrapped inside the drum and provides ample room for a full pattern, or spectrum, for qualitative analysis of the powdered material, Thus, this type of camera provides an effective means for determining the composition of a material, because the pattern obtained on the film is easily compared with films in the Hanawalt card index. These cards, published by the American Society for Testing Materials, cover more than 1500 materials.

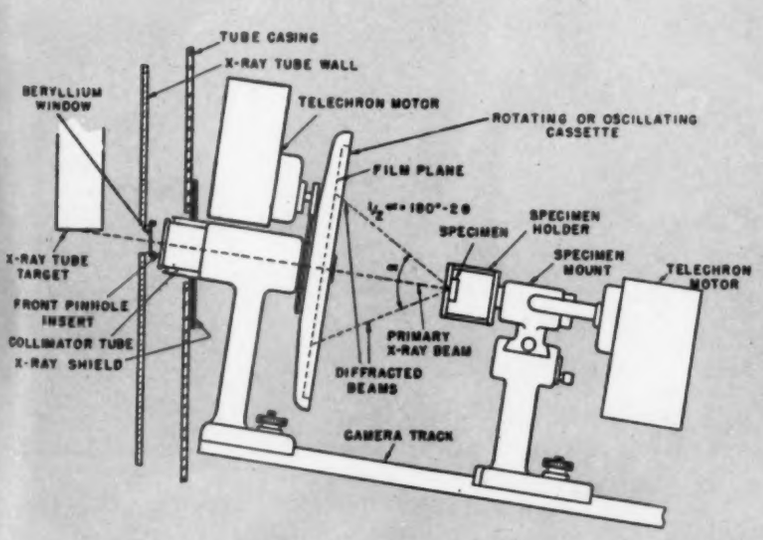
Back-Reflection Camera—This form of X-ray diffraction camera is probably the most important to production research. It will show small changes in internal structural relationships, such as are involved in studies of solid solution, precipitation of phases and effects of heat-treatment. The changes produced by alloying elements can be determined and the results plotted against composition. This type of measurement can be performed on any combination of materials that form a substitutional solid solution.

Exposure Time—The exposure time for an X-ray diffraction test varies with the accuracy desired. From 10 min. to 4 hr. may be required, depending on structure and analysis.

X-Ray Diffraction

Because of four cameras, it is possible with this equipment to carry on four identifications, comparisons or analyses at one time, using one unskilled operator





BACK-REFLECTION CAMERA

Magnetic Particle Inspection

FOR SURFACE AND NEAR-SURFACE DISCONTINUITIES

BURGESS-NORTON MFG. COMPANY

Above—After grinding, aircraft piston pins are magnetized circularly to discover defects parallel to the lengthwise axis. Below—Surface defects, material flaws and grinding cracks are located by inspection with the wet process

AN ADEQUATE program for nondestructive testing, according to the experience of many plants, must include both radiographic and magnetic particle inspection. Whereas X-rays and gamma rays will often reveal deep-seated irregularities, another method is required to find nonvisible, closelipped discontinuities at or near the surface. For the latter purpose, two inspection means are available—Magnaflux and Magnaglo. These provide indications of cracks, semi-cracks, inclusions and pores which may give rise to fatigue failure by acting as stress raisers.

These procedures can be employed in the forge shop or foundry for quality control and methods development, and in the machine shop to throw out defective material before too much work has been done on a piece, for process control and development at various stages of manufacture, and inspection of finished parts.

INSPECTION WITH MAGNAFLUX

Field of Use—Inspection with Magnaflux is recognized by Army and Navy specifications, industrial plants and tentative standards of the American Society for Testing Materials as a means for locating invisible surface and subsurface discontinuities in castings, forgings, machined parts and

CATERPILLAR TRACTOR COMPANY

weldments. The sensitivity of inspection with Magnaflux can be varied over a considerable range, and the most suitable sensitivity for a particular application is used. Evidence is given of sub-surface irregularities —crack-like inclusions and voids. There is a definite correlation between size and shape of the indication and the size and shape of the discontinuity. From cutting up samples, it has been found that the maximum depth of irregularities generally disclosed is as follows: highly finished machine parts—¼ in.; large castings and welds—¾ to 1 in.

Principle of Operation—When a magnetic article is magnetized, discontinuities give rise to localized leakage fields, which are revealed by attraction of finely divided magnetic particles. The build-up of particles at a discontinuity is known as an "indication." Iron and steel, except austenitic stainless steel, and ferromagnetic materials like Alnico, can be inspected with Magnaflux. If desired for reference purposes a scotch-tape transfer of the indication can be made, or a photograph taken. Methods for recording indications are patented.

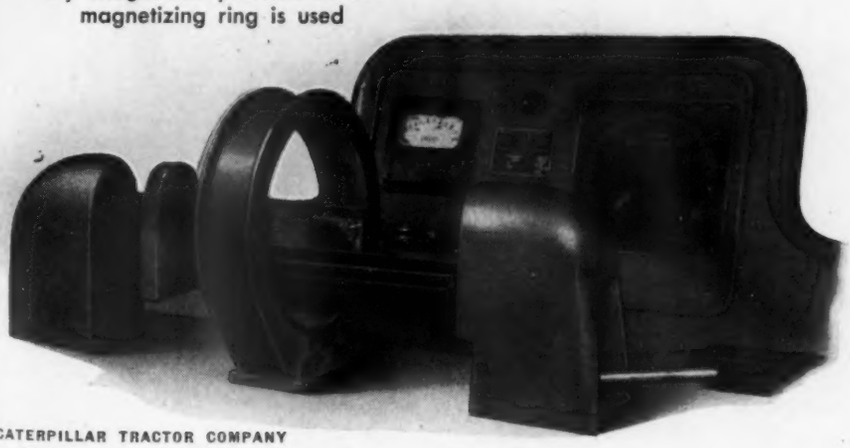
The strongest indication of a discontinuity is produced when the part is magnetized so that the direction of the magnetic field is at right angles to the fault. To inspect any area for discontinuities in any direction requires in general two operations involving separate magnetizations, usually at right angles to each other. When relatively small, simple parts are inspected, these two operations are circular and longitudinal magnetization, and the entire area of the part is inspected at one time.

Circular magnetization is induced by passing the current through the part or a portion of it, or by threading a conductor through an opening. Faults that run more or less parallel to the direction of current flow will be revealed by interruptions in the circular field. On the other hand, faults at right angles to the part's axis are discovered by longitudinal magnetization. This is induced by placing the workpiece within a solenoid or coil, or by wrapping a cable around the object. Most manufactured parts are conveniently magnetized and inspected with general-purpose machines, but high-production special setups are often more convenient, when time, number of personnel and cost factors are considered.

Both d.c. and a.c. are used for magnetization. The former is useful in finding significant sub-surface discontinuities: because of "skin effect" the latter is limited to location of discontinuities open at the surface or very near the surface. Therefore d.c. is commonly used for inspection of welds and castings while a.c. is used for checking highly finished machined parts; but exceptions are made to suit conditions.

Two types of inspection media are employed. In the wet method, the magnetic particles are prepared in paste form and mixed with oil. The resulting bath is either used for flowing over the magnetized parts or dipping. The wet method is more sensitive to tiny surface discontinuities. In the dry method, which is more sensitive to sub-surface discontinuities, magnetic powder is dusted or blown upon the magnetized pieces. Magnaflux powders and paste are made in different colors to give best contrast of an indication with the surface of parts being inspected. For

Spline shafts are inspected with dry Magnaflux powder. A demagnetizing ring is used



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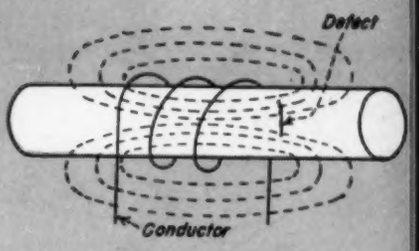
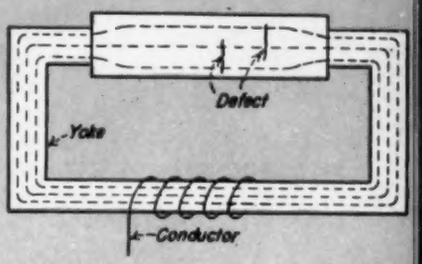
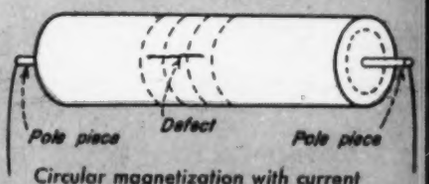
MAGNETIZING METHODS



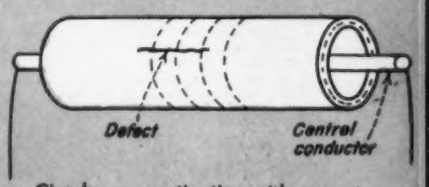
Longitudinal magnetization



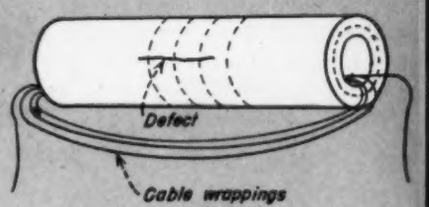
Longitudinal magnetization with yokes



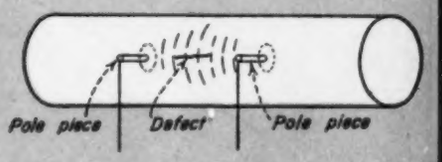
Circular magnetization with current passing directly through forging



Circular magnetization with current passing through a central conductor



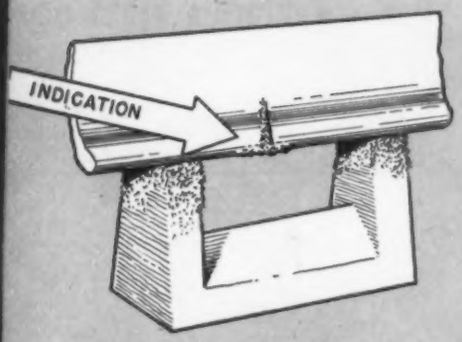
Circular magnetization with conductors threaded through forging



Circular magnetization with "prod" type contacts

DIRECTION OF FIELD—For optimum indications, the direction of the magnetic field should be nearly at right angles to the defect

MAGNETIC PARTICLE INSPECTION



Discontinuities give rise to leakage fields, which are revealed by build-up of magnetic particles. A crack is shown here by the "indication"

FLUORESCENT PENETRANT INSPECTION

1. PENETRATION
A fluorescent penetrant seeps into a crack open to the surface

2. REMOVING EXCESS
Excess penetrant is washed or wiped from the surface

3. DEVELOPMENT
A developer acts like a blotter to draw the penetrant out of the crack and spread it

4. INSPECTION
Black light causes penetrant to glow in a darkened inclosure

Glowing indications reveal the unsuspected presence of service cracks on a stellite-faced valve

Penetration Time for Fluorescent Process

MATERIAL AND CONDITION	TYPES OF DEFECT	PENETRATING TIME, MAX.
Castings:		
Sand, Permanent mold, Diecastings	Shrinkage cracks, Shrinkage porosity, Surface porosity	5-10 min.
	Cold shuts	20 min.
Forgings	Cracks, Laps	30 min.
Metal Rollings	Seams	30 min. to 3 hr.
Welds	Cracks, Pores	20 min.
	Included flux	1-5 min.
On all of the foregoing	Heat-treat cracks, Grinding cracks, Fatigue cracks	30 min.
Plastics	Cracks	1-5 min.
Carbide-tipped tools	Poor braze, Cracks in tip	15 min.

example, pearl gray powder is generally used for overhaul inspection of steam locomotive parts; whereas black powder is used to inspect sand-blasted castings.

Application of the inspection medium may be simultaneous with or subsequent to magnetization. The first is known as the continuous method, the second as the residual method. Their selection depends on sensitivity requirements and the amount of magnetism retained. If sufficient sensitivity can be obtained with the residual method, it is preferred because inspection is simplified.

Interpretation of indications is dependent upon experience with and a knowledge of the history of a specific part. Stereotyped interpretation of indications is impractical. The inspector must be trained in the stress and service problems of the part he is handling, and be given some kind of standard which states the locations where discontinuities of a specific kind, size and shape are to be considered defects.

INSPECTION WITH MAGNAGLO

Fluorescent magnetic particle inspection with Magnaglo was developed to assist inspectors to find small or shadowy indications on work of complex contour such as splined shafts, gears, hobs, milling cutters and production parts. Thus the use of Magnaglo is advantageous where non-fluorescent materials do not give good contrast, extreme sensitivity is needed, it is necessary to use low magnetic field strengths to avoid non-revelant indications. The Magnaglo paste is suspended in oil, and the parts are inspected by the regular wet method, but they are examined in a darkened inclosure under near-ultra-violet, or "black" light. Indications of discontinuities appear as bright greenish-yellow lines of fluorescence. These indications are more readily seen than Magnaflux indications.

FLUORESCENT PENETRANT INSPECTION

Discontinuities in non-magnetic materials cannot be located by inspection with Magnaflux and Magnaglo. Hence, parts made of any material but especially austenitic stainless steel, aluminum, brass, bronze and carbides, are inspected with Zyglo, which uses a fluorescent penetrant. Moreover, magnetic parts like ball bearings are inspected with Zyglo because of the handling problem and lack of a suitable magnetizing method. Either batch or automatic operation can be used.

In inspection with Zyglo, the workpieces are dipped (sometimes sprayed or brushed) into a penetrant which contains a highly fluorescent material. They are next washed in the case of an emulsifiable penetrant. Non-emulsifiable penetrants are removed from the surface by wiping or solvents. Finally a developer is applied to help draw the penetrant from the depths of the defect and spread it on the surface of the piece for a short distance on each side of the discontinuity. When viewed under black light, discontinuities not visible to the eye will be revealed.

Supersonic Inspection

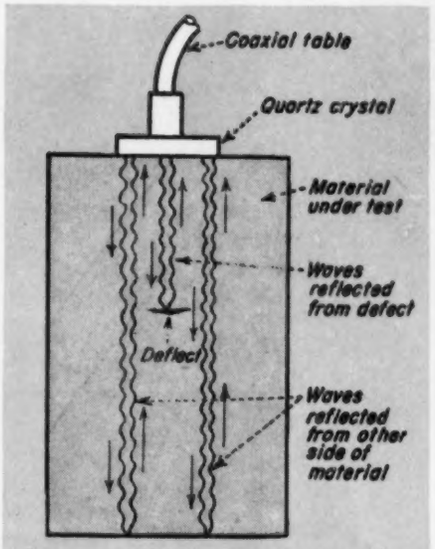
REVEALS LAMINATIONS AND DEEP-SEATED FLAWS

IT HAS BEEN long known that sound travels better through a solid than through air. But there are several types of sound waves. Those which are audible to the human ear cannot be beamed as satisfactorily as the longitudinal sound waves of extremely short wavelength. However, as with other sound waves, the longitudinal waves travel through a given material at a velocity corresponding to the substance's density and elastic properties. Thus, a change in velocity, or loss of energy, will occur when the sound beam strikes an irregularity—a crack, separation, inclusion or blowhole. Modern electrical circuits can pick up such minute changes in energy level that it is possible to find a separation only 0.001 in. thick. And since sound will penetrate solids to great depths, it is possible to locate defects far beyond the reach of X-ray. Complete safety to personnel is assured because the equipment does not generate rays. Moreover, the operator can be trained within a short period.

SPERRY SUPERSONIC REFLECTOSCOPE

Field of Use—To detect sub-surface defects—cracks, voids, ruptures, inclusions and intermediate defects such as secondary pipe, shrinkage cavities and flakes—in products of fairly uniform thickness and at depths from 1 to 28 ft. Flaws at depths from ⅛ in. to 10 ft. are rather easily found in steel, iron, aluminum or magnesium. Bronze and brass articles can be inspected, but copper has a structure that tends to dampen the sound waves used in testing. Plastics with high resin content can be penetrated to several inches in depth. Those without high resin content reduce the effect to approximately ½ in. maximum. With plastics, an obvious separation can be found easily, but inclusions or non-homogeneous structure are not so easily discovered.

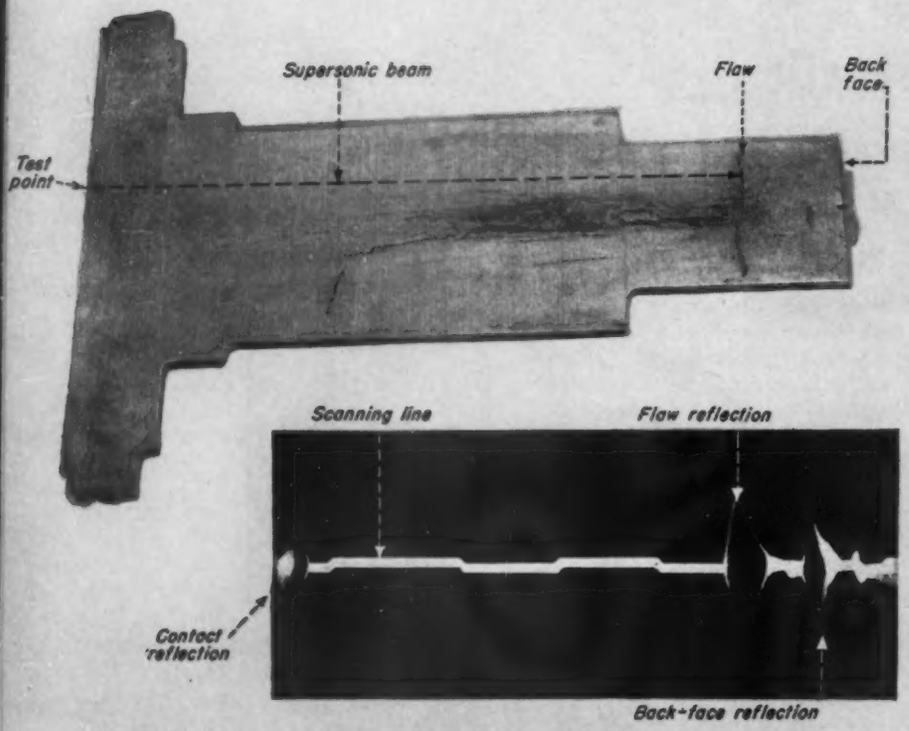
Principle of Operation—Internal defects are detected by sending supersonic impulses (inaudible high-frequency sound waves of 0.5 to 11 megacycles) into the material under test and measuring the time required for these impulses to penetrate the material, be reflected from the opposite side or the defect and return to the sending point. The sound waves are dispatched by a quartz crystal (approximately ½ in. sq. to 1 in. sq.) which is moved over the work surface. An oil film between the crystal and the work is required in order to obtain proper transmission of sound energy, and the work surface must be finished to smoothness of at least 125-250 micro-inches rms. Glycerine, mixed with a wetting agent permits testing of rougher surfaces. In addition the crystal must conform to the work contour.



As the quartz crystal of the Reflectoscope is moved over a suitably prepared work surface, sound waves are reflected by the rear surface or by defects

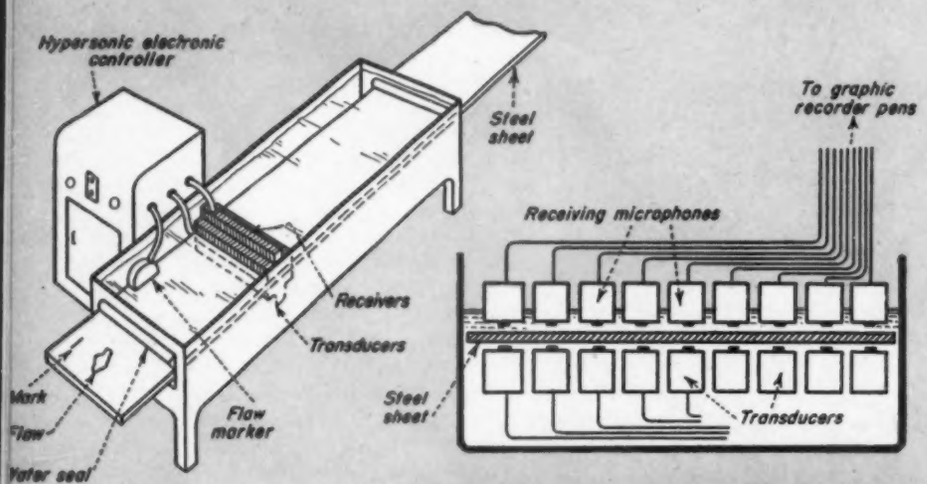
Mechanical handling setups, when used in conjunction with the Sperry Supersonic Reflectoscope, aid rapid location of deep-seated defects

Depth of Defect—The operator views the screen of a cathode-ray oscilloscope, upon which a scanning line is projected. The wave form of the scanning line is compressed or extended by suitable control so that one full wave represents any depth from 1 in. to 2 ft. Electrical oscillations of the selected frequency are impressed on the crystal, causing it to vibrate and radiate a sound beam into the material, but only for a few micro-seconds and at intervals of 60 times per second. The remaining time in each interval permits the crystal, now acting as a receiver, to pick up the reflected vibration which is transformed into electrical im-



HOW REFLECTOSCOPE INDICATES DEPTH OF FLAW

Above—Sectioned forging. Below—Photograph of oscilloscope indication for flaw indicated in forging. The scanning line can be adjusted so that one full wave equals any measure of depth from one inch to two feet. By adjusting the scanning line, it is possible to measure depths to 28 ft.



SCHEMATIC ARRANGEMENT OF HYPERSONIC ANALYZER

In this proposal for high-speed examination of strip steel for laminations, nine transducers and receivers are set up across the moving material and transmit information to a recorder. A signaling device or a marker can be employed to indicate thin defects

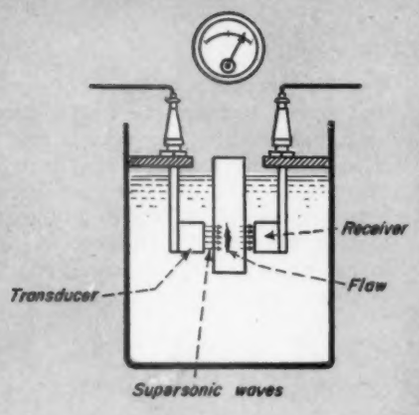
pulses and impressed upon the oscilloscope screen. The occurrence of peaks at various points upon the scanning line indicate respectively: (1) the initial pulse, (2) any irregularities in the material, and (3) the back-face reflection. Since the scanning line is preset to a selected scale for depth, it is easy to estimate the depth of the defect within ⅛ in.

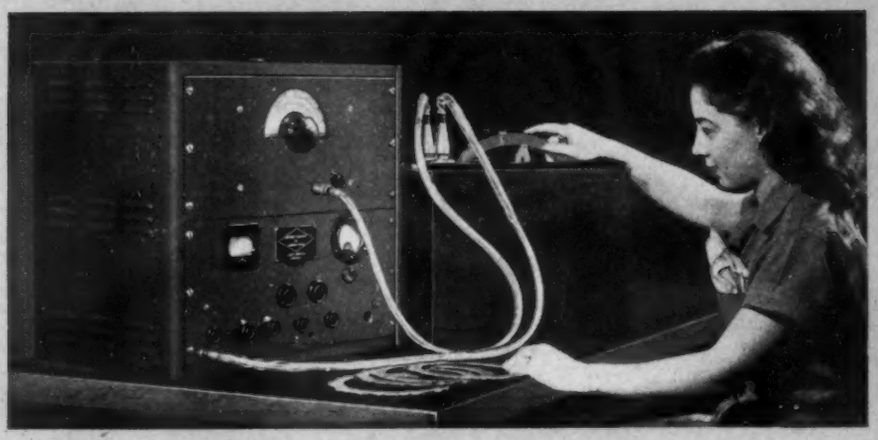
Size of Defect—The minimum diameter of flaw detected is 1/10 of 1% of the distance through the material from the contact face. Thus, a flaw ⅛ in. in diameter can be found at a depth of 10 ft., and proportionately smaller flaws at shorter distances from the contact point. Possibly the smallest irregularity that can be found is 0.001 in. in diameter by 0.003 in. long. Only that portion of an irregularity which is perpendicular to the sound wave causes an indication. Hence the projected area of the defect in a plane parallel to the contact face is found by moving the search unit (crystal) over the face of the workpiece. For small flaws, the major dimension can be found by decreasing the testing frequency until the indication disappears. Then the major dimension equals the supersonic wave length.

General Advantages—Testing can be done at any required point on the piece. The 175-lb. tester is mounted on a carriage. Therefore, it can be transported around the plant for quality control or used for routine maintenance checkups without dismantling the inspected equipment. Access is required only from one side of the assembly to find fatigue cracks or flaws in truck axles, locomotive axles, air-compressor shafts, diesel-engine shafts and other highly stressed components.

Limitations—Rough forgings and castings should be finished (with a hand grinder if need be) so that the test surface has a surface finish of 125-250 micro-inches rms, (rougher with glycerine) and this work surface must be homogeneous. Thus, the surface must be either all metal or all smoothly finished, tightly adherent scale. Crystal search units must be shaped to the contour of the workpiece. Flat crystals adapted for use on flat surfaces cannot be used on smaller than 11-in. rolls. At present, the smallest diameter tested from the side is approximately 1 in.

Mechanized Setups—When repetitive parts must be inspected for flaws it is feasible to use a gravity-roller





FINDS LAMINATIONS. With the tank-type Sperry Thruray, the operator moves the part between searching units, observes "good" or "bad" signals on the dial. This equipment has been adapted to inspection of strip

conveyor to transport the pieces past the inspection machine.

Records—If desired, the operator can quickly mount a camera on the supersonic flaw detector to photograph the indication appearing on the oscilloscope screen.

BRUSH HYPERSONIC ANALYZER

Field of Use—The Brush Development Company's "Hypersonic" analyzer is best suited to detection of separations or thin pipes in material produced on a mass-production basis. The thinner materials such as plates, sheets and strip are examples. Mill-type installations are projected for such purposes, and experimental work is being done on detection of laminations in square forged billets, the adherence of copper plating to stainless steel, and the quality of bonds in cycle-welded joints.

Principle of Operation—Customarily the operation is carried out with material passing through a water bath, although air will serve as a carrier of the supersonic sound beam. Two crystal units are used; one is a transmitter and the other is a receiver. The workpieces or material to be examined must be passed between the two crystals, while a continuous supersonic beam is projected by the apparatus. The sound energy picked up by the receiver is converted into electrical energy for operating a recorder. Any change in the energy received at the recorder causes the pen to indicate by means of a peak, and the point on the passing material can be marked with respect to the existence of a flaw.

Depth and Size of Flaw—The Hypersonic analyzer does not give a direct indication of the depth of a flaw. Perhaps in some installations it may be possible to estimate the depth of a separation, but usually an installation is intended solely for finding separations and throwing out defective material. It is possible to obtain a positive indication of flaws in the shape of slits 0.001 in. wide. Spherical voids of 1/32 in. in diameter can be detected.

Advantages—The equipment can be operated at fairly rapid speeds. The mechanical handling systems can be arranged. Separations as thin as 0.001 in. can be detected. Steel, aluminum, phosphor bronze, beryllium copper, brass, plastics and extruded materials can be inspected.

Limitations—In general, the test shows only the existence of a separation, but not its nature and depth, and often it gives only a rough indication of the area. There has been little success to date in obtaining positive correlation of Hypersonic analyzer readings with tests on welds.

SPERRY SUPERSONIC THRURAY

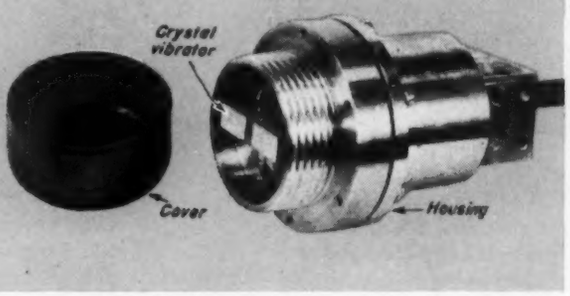
Field of Use—To compare production parts with a standard part for soundness of spot welds, the occurrence of laminations in sheet products, the quality of bond in bi-metals, the quality of bond in clad and plated materials, and the homogeneity of sintered materials.

Principle of Operation—As with the Brush "Hypersonic" equipment, the workpiece is placed between two searching units which are immersed in oil or water. One searching unit transmits the supersonic vibration, and the other acts as a receiver.

Advantages—This equipment provides a cheap, quick means of inspecting many kinds of product parts for defects. An operator can be trained to use the Thruray in two days. New setups are easily made.

Limitations—Corrosion and cleaning problems are introduced by the necessity for using a fluid medium for transmission of the sound waves through the workpieces. Further, any irregularity in the part is revealed, but not its over-all extent or depth. Thus, the equipment should be limited to applications where any change from standard is unsatisfactory and the operator is not permitted to exercise his judgment in respect to irregularities or flaws.

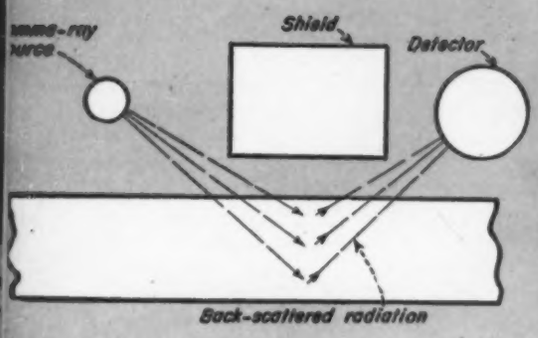
With the Hypersonic unit the transducer does not contact the material. However, it is necessary to maintain an air gap that is fairly uniform for consistent results



Thickness Gages

MEASURE IRREGULARITIES IN TUBING

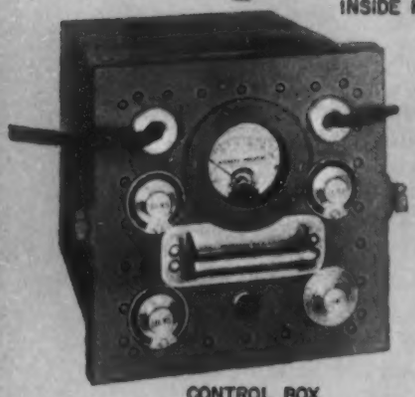
Two oil companies had need of equipment that would measure the wall thickness of pipe, tubing, pressure vessels and detect cracks and corrosion. The instruments evolved operate on different principles, but both seem to have application in metal-fabricating operations as well as in maintenance work. Available details of these new instruments are:



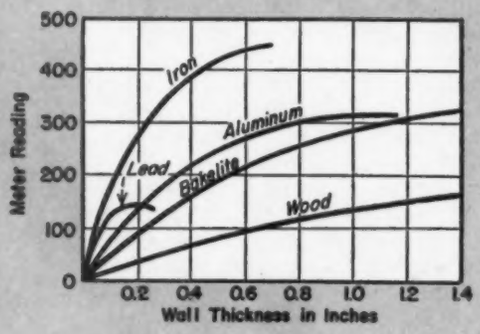
PRINCIPLE OF OPERATION

INSIDE HEAD IN TUBE

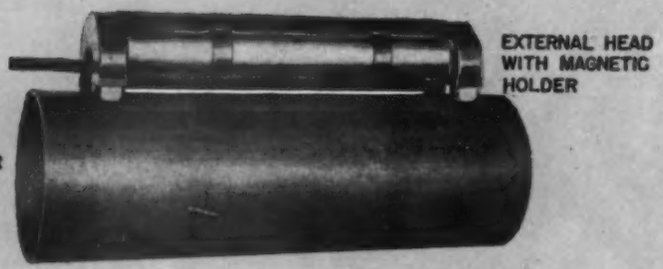
INSIDE HEAD WITH CALIBRATION STRIPS



CONTROL BOX



CALIBRATION CURVES FOR FLAT PLATES



By proper calibration of the Penetron against standard specimens of tubing or flat plates of known thickness, the readings obtained are readily converted to wall thickness of the object being measured

PENETRON THICKNESS GAGE

Field of Use—Gamma rays are utilized by the Penetron to measure the thickness of pipes, tubes, cylinders and pressure vessels from one side without affecting the material. This is a distinct advantage where alloy steels are involved, bacause the familiar calipering method involves drilling a hole, taking the measurement, fitting the hole with a screw plug and welding the plug. The welded area is usually weaker than the original structure if highly alloyed steels are involved. Wall thicknesses up to ¾ in. can be measured within an accuracy of ±3%.

Principle of Operation—The Penetron consists of a head connected to a control by 75 ft. of cable. The head is made of steel tube, and houses a needle containing a quantity of radium salts, a shield for directing the gamma rays into the specimen at an angle, a detector unit and a pre-amplifier. The gamma rays may pass through the metal entirely or be scattered in all directions by the atomic structure. Scattered rays emerging on the same side of the material as the side of entrance are termed back-scattered radiation. For metal of given composition, the back-scattered radiation increases as a direct function of wall thickness. Thus rays picked up by the detector enter a gamma-ray radiation detector, setting off current discharges, or pulses. These pulses are increased in power by the pre-amplifier and transmitted to the control box containing a measuring circuit.

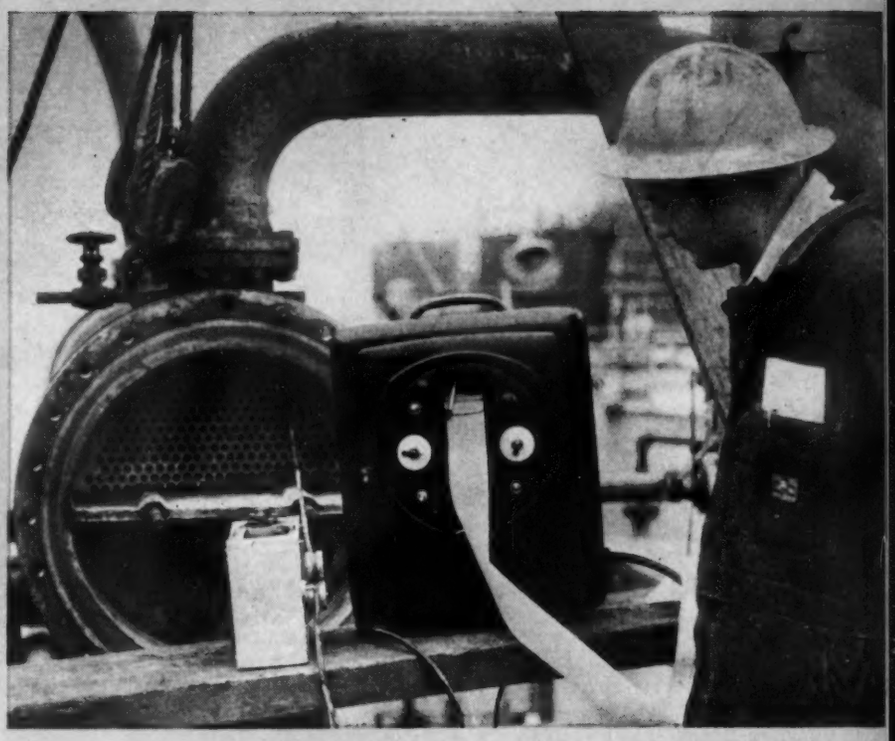
Advantages—The Penetron can be used on the exterior or interior of cylinders, and also on flat plates. Iron, steel, aluminum, plastics and wood can be checked as desired. The equipment is portable and weighs approximately 25 lb. complete.

Limitations — Average thickness over one square inch is measured by the Penetron. Hence, the instrument cannot be used for detection of pin-

holes, pin-hole corrosion, fine cracks or laminations. As emission of gamma rays is irregular, the minimum time per reading with the Penetron is approximately 25 seconds.

PROBOLOG TUBE INSPECTOR

An electronic principle used in the Probolog to detect and record internal defects such as pin-holes, cracks, corrosion and erosion pits, also differences in chemical composition in tubes of non-magnetic materials. Copper, brass, Monel, Admiralty metal, copper-nickel, aluminum, magnesium and austenitic stainless-steel tubes from 1 to 12 in. O.D. can be handled with the probes available. For basic reasons, the Probolog discussed is unsuited to the examination of steel tubes. A modified instrument for use upon magnetic materials is under development.



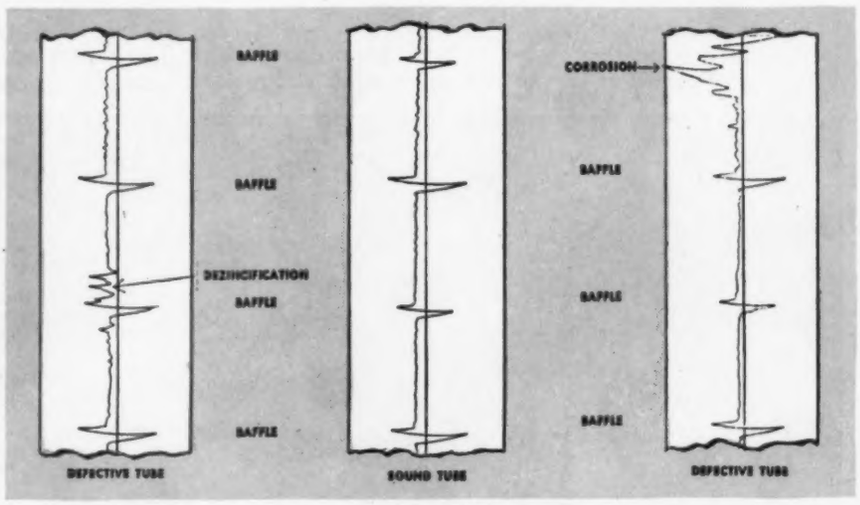
First application of the Probolog was in the oil refineries where it was desirable to use a non-destructive test on condenser tubes

Components—In its present form the Probolog consists of these parts: (a) one or more interchangeable probes of diameters to fit standard sizes of tubing, (b) a mechanical probe puller, which is usually synchronized with the chart drive of the recorder to insure a reproducible record, and (c) an electronic recorder, equipped with a continuous strip chart but also incorporating a neon blinker which may be used as an indicator when a record is not required. The standard commercial model requires 110 v., 60-cycle ac. as a power source.

Inspection Procedure—Most of the experience gained with this instrument has been connection with heat exchangers in oil refineries. Other applications are found in chemical plants, power plants, aboard ship and in industrial plants using heat exchangers. Those who are engaged in the repair of such equipment can use the Probolog to advantage, according to these methods:

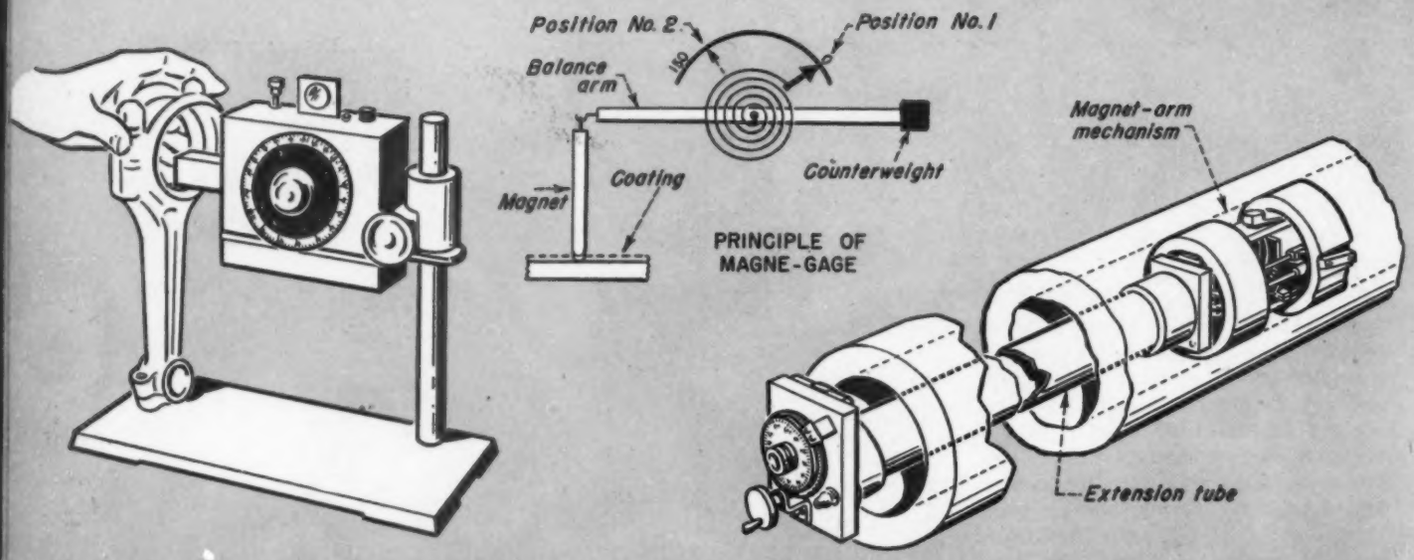
1. To make a rapid survey of all tubes, first use the instrument as a visual indicator, with the chart drive and the probe puller inactive. The neon light is set to flash whenever a signal exceeding a specified minimum intensity is transmitted by the probe. The operator explores the tube as rapidly as he can pull the probe through. Tubes shown by flashes of the neon light to contain defective areas are marked for further inspection, and the remainder passed as satisfactory.

2. A second inspection of the marked tubes is then made, using the strip-chart recorder and the probe puller synchronized, to draw the probe through the tube at a standard rate, say 10 ft. per min. A permanent record is thus obtained of the internal condition of each suspected tube, in which each defect is located along the tube. The record of a faulty tube consists of a series of deflections from a central line, and the magnitude of each deflection is proportional to the extent of the defect.



Typical Probolog records made on condenser tubes. Left—Log of defective tube from upper pass. Center—Sound tube. Right—Tube from lower pass is corroded near one end, may be salvaged for shorter condensers

Advantages—In oil refinery work, the Probolog has saved many tubes from the scrap heap. The good tubes are easily separated from the bad. Also, the defective area of tubes may be more or less concentrated within a limited distance from one end. In such cases, only the defective end need be removed, and the shortened tube can be used in other condensers.



Left—With an extension arm, the Magne-Gage can be used to measure bearing thickness. Right—Extension tubes permit inserting the head as deep as 30 ft. in tubes or cylinders.

Film Thickness Gages

MEASURE FROM ONE SIDE OF COATING

THROUGH the use of electrical principles, gages have been designed to measure the thickness of films on magnetic and non-magnetic base materials without cutting through the coating. These tests can be made rapidly, have reasonable accuracy and can be employed for checking finished products and in process-control work. By and large, the fields of use of the several instruments now available do not overlap. Details are:

MAGNE-GAGE

With the Magne-Gage, the thickness of these coatings can be measured.

1. Nickel coatings up to 0.001 in. thick on non-magnetic base metals, such as copper, brass and zinc-base diecastings.
2. Polished nickel coatings up to 0.002 in. thick on iron or steel.
3. Non-magnetic coatings up to 0.080 in. thick on iron or steel. Such coatings may be electro-deposited copper, zinc, cadmium, tin or chromium; hot-dipped tin, zinc or lead; non-metallic paint or vitreous enamel, or clad by rolling or forging.

Principle of Operation—The Magne-Gage operates on the basis of breaking the magnetic attraction between a calibrated magnet and the magnetic coating or magnetic-base material. This is done by turning a graduated dial, which actuates a spiral torsion spring attached to a horizontal lever arm supporting the magnet. Dial readings are averaged and converted to coating thickness by reference to a calibration curve.

If the coating is non-magnetic, the force required to pull the magnet away from bare magnetic material exceeds the force required to pull the magnet from coated material. When nickel coatings are applied to non-magnetic materials, the force required to rupture contact is directly proportional to the coating thickness.

Limitations—The accuracy is stated to be ± 10% for coatings thicker than 0.002 in. To keep within this range, these precautions should be observed:

1. Coatings on cylinders larger than ¼ in. in diameter and spheres larger than ¾ in. in diameter can be measured without need of a correction factor.
2. For nickel coatings, the measurement should not be made closer than

Rapid, direct reading of the G. E. thickness gage adapts it to measuring thickness of copper plating on small electronic-tube parts

0.15 in. to the edge of the material.

3. Measurements cannot be taken on flat pieces of ¾ in. sq. or smaller without special calibration.

G.E. THICKNESS GAGES

Thickness of non-magnetic coatings on magnetic iron or steel are measured with gages made in two ranges:

Type A is primarily used for measuring plating thickness on small areas or in confined spaces and has a range of 0.00005 to 0.01 in.

Type B measures the thickness of paints, porcelain enamel, heavy platings and bearing linings and has a range from 0.0001 to 0.10 in.

Principle of Operation—These gages operate on the principle that any non-magnetic material applied to an iron or steel base constitutes an air gap between gage and magnetic base.

The gaging head incorporates two magnetic pole tips or flanges. When these flanges are placed against the surface of the non-magnetic coating, a magnetizing current in the gage head sets up a magnetic flux which threads through the iron core of the gage head, across the two small air gaps imposed by the non-magnetic material and through the iron or steel base. The reluctance of this flux path is predominantly a function of the length of air gap in the magnetic circuit. The indicating instrument is calibrated to read coating thickness directly.

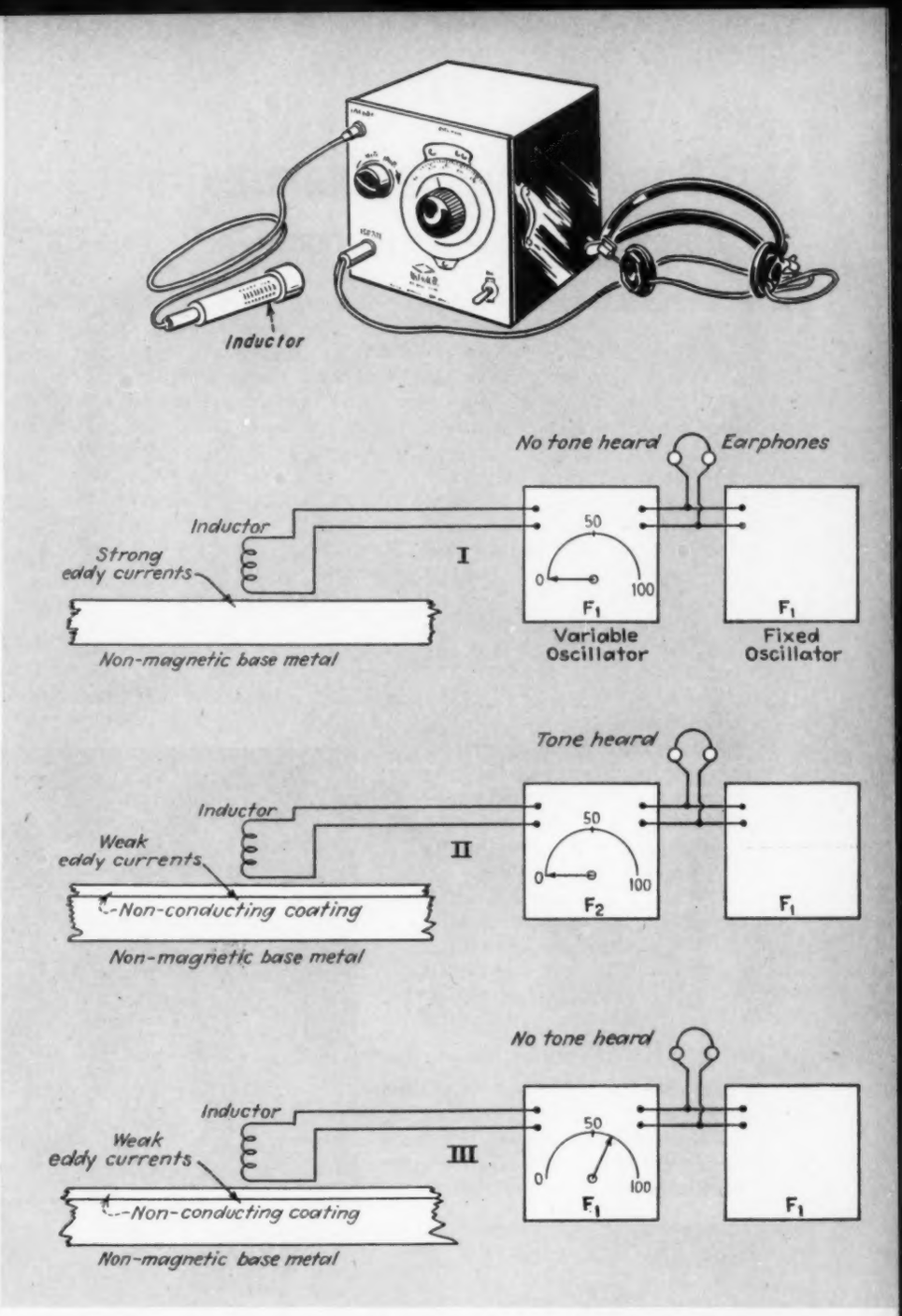
FILMETER

Thickness of non-conducting coatings on non-magnetic base metals (aluminum, duralumin, brass, copper and bronze) can be measured. Paint, varnish, shellac, lacquer, enamel, plastics and ceramics from zero to 0.005 in. thick can be measured with an accuracy of 3% of full scale, and measurements can be taken on flat surfaces or on convex or concave surfaces of not less than 6 in. diameter.

A modification of the instrument will measure anodized films from zero to 0.001 in. thickness on aluminum.

Principle of Operation—The instrument is based on the inductance effect that the coated base metal has on the coil in the inductor (search coil) when applied to the coating. Current flowing in the search coil induces eddy currents in the base metal, and the intensity of these currents varies with the distance (coating thickness) between the search coil and the base metal. The coil is connected to an oscillator, whose frequency is changed by the eddy currents. The change in frequency is measured with a variable condenser.

Diagram I in an accompanying illustration shows the search coil placed on the bare metal for zero adjustment, which consists of setting both oscillators to frequency F. When the unit is placed on coated metal, diagram II, the frequency of the variable oscillator is changed to F_2 and a tone equal in frequency to F_1—F_2 will be heard. If the dial is turned until no tone is heard, the dial reading will be proportional to the coating thickness. Conversion of dial reading to thickness is made with a calibration curve. Calibration is effected with mica samples.



Dial of the Filmeter is turned until a tone is no longer heard, and the reading is converted by calibration curve to thickness of coating

Advantages—The instrument weighs only 11 lb., is battery operated, and can be suspended from a strap, leaving both hands free to operate the inductor and controls.

Limitations—There is no limitation on maximum thickness of the base metal, but for copper and aluminum the minimum thickness is 0.011 in., and for brass and bronze, 0.020 in.

Spectrographic Examination

QUICKLY DETERMINES MATERIAL ANALYSIS

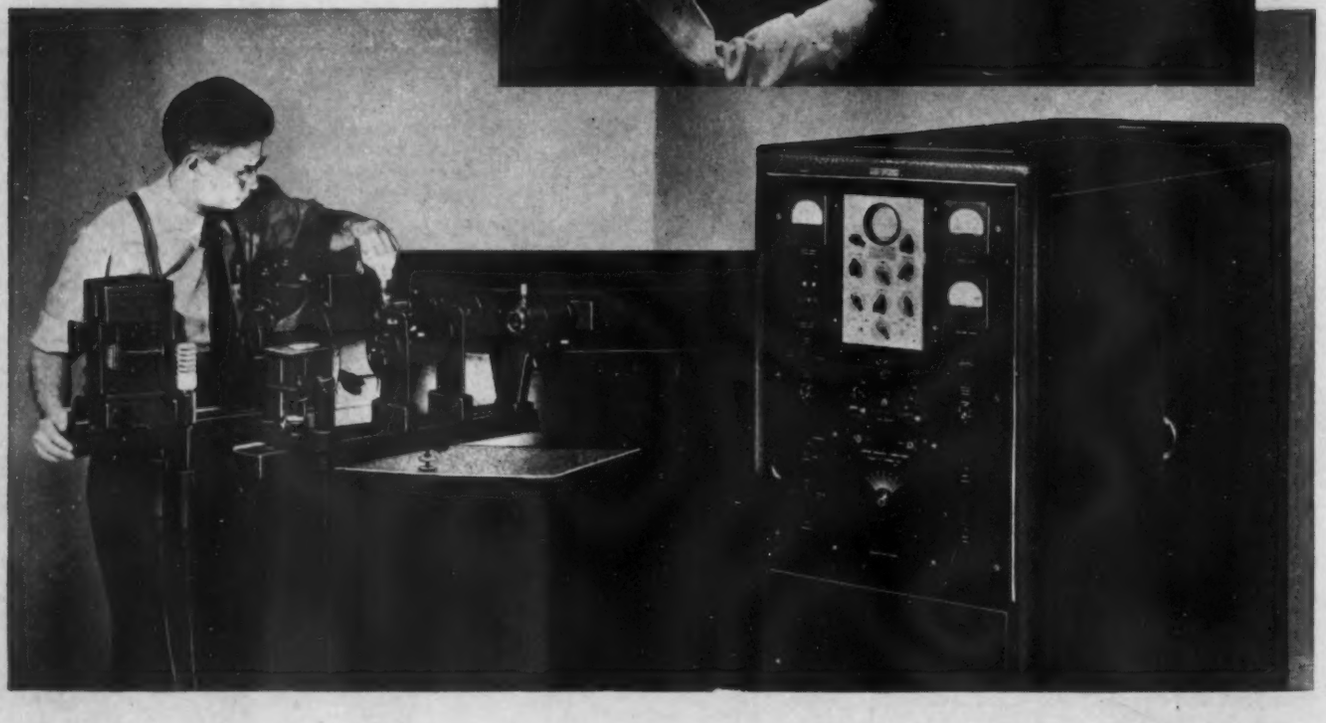
IN A MATTER of minutes a highly accurate analysis of a material can be made by either of two somewhat related methods: (1) spectrography and (2) X-ray spectrometry. Applications may take several directions:

(a) To check incoming shipments of material for grade or structure. For example, steels presently contain a greater content of residual alloy than in prewar days. There is a distinct possibility that nickel, chromium and molybdenum will be present in the scrap from which the steel is made. If the consumer is not aware of the molybdenum content, for example, he may have difficulty in heat-treatment. Quite a few plants installed spectrographic equipment during the war for checking steels against specifications, and prominent mass-production firms are purchasing outfits for peacetime control measures.

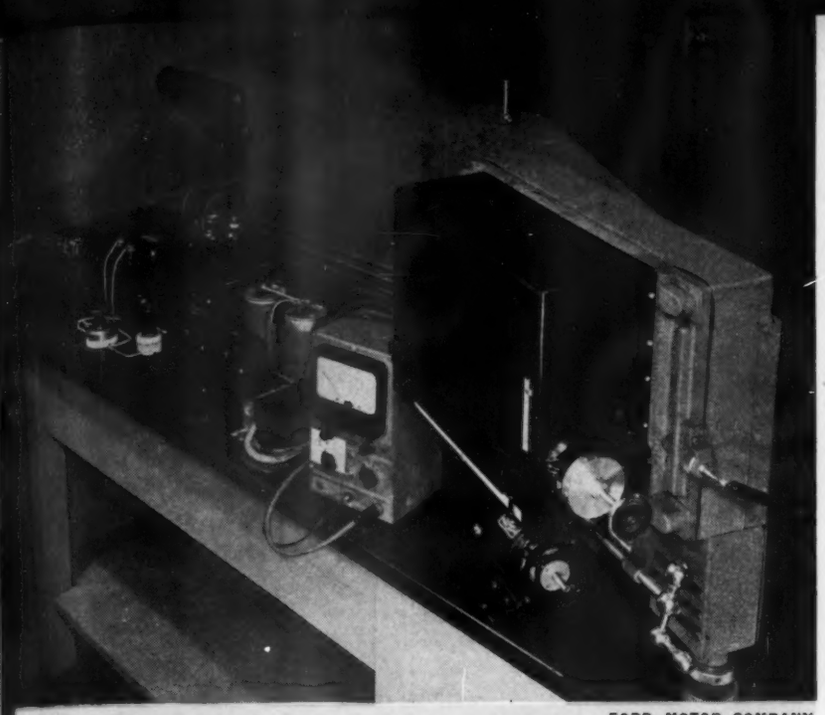
The structure of materials often has a strong bearing upon their suitability for the intended use. Recently, a large auto manufacturer was forced to scrap a large quantity of cemented carbides purchased for tool-tipping purposes. Much of this material crumbled when put into service. The vendors held the opinion that setups had been drastically changed. To save further arguments and to avoid production tieups, the auto concern proposes to use an X-ray spectrometer to check the structure of all future receipts of carbides and will reject any that do not show a structure akin to that of satisfactory samples.

(b) The development of materials (diecasting alloys have been an example) and their control in manufacture.

If a material is volatilized in a flame or arc, the flame is a fingerprint of the material. This is true because the radiant energy for each and every substance has a specific wavelength. Hence if all rays of light emitted by the burning specimen are broken down into a spectrum by a prism or diffraction grating, the pattern of bands reveals the substances present. Photography is chosen because many of the rays are in the non-visible range and can best be detected with special film. The developed spectrogram can be analyzed by an instrument like a comparator-densitometer, which evaluates spectral lines and compares their positions with those on a master film for the material. Coincidence between identifying spectral lines for certain elements on the two films makes qualitative identification easy. A quantitative analysis for any element



A spectrum having the same dispersion in all regions can be produced on the grating type spectrograph (below) for easy measurement of spectral lines on the comparator-densitometer at right



FORD MOTOR COMPANY

A calibrated scale in this spectrographic installation shows percentages of elements present in aluminum and magnesium alloys. The complete analysis is made in 2 to 3 min.

Through analysis of ultimate structure, a recording X-ray spectrometer provides a means for rapid identification and comparison and control over various alloyed materials

is obtained by reading the density of the spectral line.

Technique—The spectrograph is a practical production tool because of the simplicity of sampling techniques. Metallic samples can be used as electrodes and an arc or spark passed between them. Or the powdered material may be tamped in a hollow electrode. But a flat surface about ⅜ in. in diameter may be ground unobtrusively on castings, forgings and even machined parts. This flat surface can be used as one electrode and the body of the object supported on an adjustable table. The flat surface technique permits analysis of rough or finished parts where determination of carbon, phosphorous and sulphur is not necessary.

Flat-surface sparking is a speedy method of analysis. Samples can be analyzed in 15 min. for these elements: nickel, chromium, molybdenum, manganese, silicon, copper, vanadium and aluminum. Actually the tests can be carried out for a few cents each. Nevertheless, the results can be accurate. Maximum deviations from known standard values lie between 3 and 5% for any of above elements, according to experience of industrial users. So when the National Bureau of Standards series of spectrographic standards covering a number of steels is used, accuracy becomes a matter of reproducability. And there are other tasks than metals control for which the spectrograph can be used. For example, pigments and paints can be analyzed.

In the setup used at the Ford Motor Company (see accompanying photograph) analyses of magnesium and aluminum alloys are made of each melt in about two to three minutes. A recheck can be made easily on the castings by striking an arc on a surface that is to be machined or at some point on finished pieces where a slight burn will not affect its usefulness. In this setup, the black box on the side of the spectrograph carries a screen with slits at critical lines. Each slit allows rays from the sample and corresponding to a certain element to strike a photo cell. The intensity of the beam is a measure of the percentage of that element in the alloy. A dial on an adjacent meter is calibrated to read the percentages of aluminum, magnesium, zinc, lead, iron, copper or nickel in the alloy. A range knob brings in the various photo cells so that each element can be read in turn.

X-RAY SPECTROMETER

Principle of Operation—The X-ray spectrometer is a recent development springing from the need for a faster means of effecting X-ray diffraction analysis. To eliminate film and the time required for film processing, a sensitive Geiger counter is substituted. Employed in conjunction with suitable electronic coupling circuits, the tube, driven over a quadrant by a scanning motor, sweeps through the spectrum produced by the irradiation of the specimen by an X-ray source and causes a resultant trace to appear on the chart of a recorder. The recorder trace shows the angular disposition of the diffracted beams and gives the measure of their respective intensities.

Where metallic specimens are employed, they may be in the form of coupons or slugs with one face ground and polished. Or a small amount of the specimen may be powdered, mounted on a flat slide and inserted in a specimen holder. A chart of the specimen can be completed automatically in a matter of minutes. Often only one or two spectrum lines will tell the whole story, thereby further reducing the time of investigation and making the apparatus highly useful in process control.

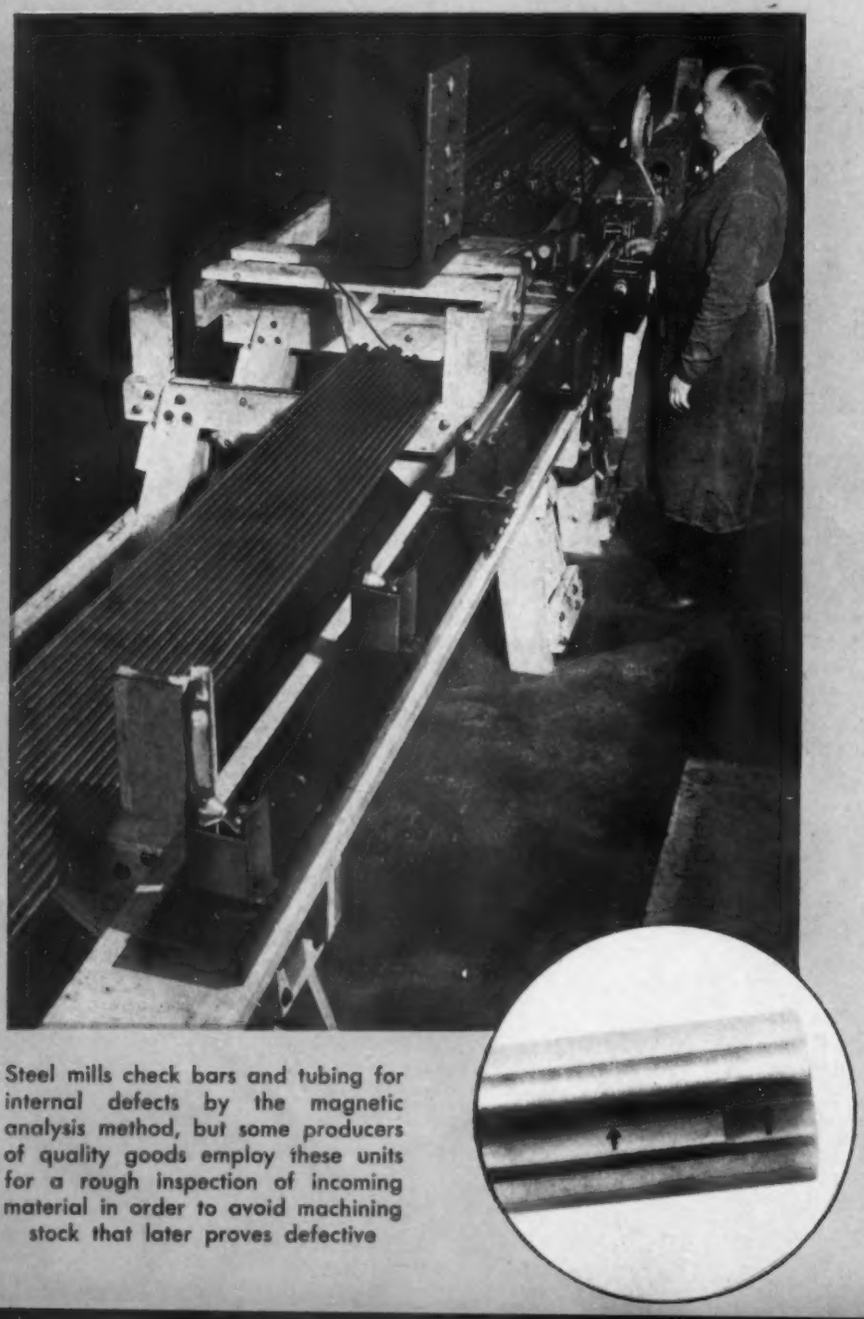
Advantages—An easily read chart record gives the constituents of a sample and their relative amounts. The chart is available in a few minutes instead of hours as is the case when film methods are used. Routine examination of samples for specification checks or sorting purposes can often be handled by an unskilled person. Laboratory control of powder-metallurgy products is an example of routine inspection to prevent non-homogeneous structures. Research and process control in the fields mentioned under X-ray diffraction are also functions of the equipment.

Magnetic Analysis Inspection

SALVAGES MATERIAL, CONTROLS PROCESSES

THE MAGNETIC properties of irons and steels vary with their physical, chemical and metallurgical properties. Therefore, by suitable electronic devices, it is possible to obtain indications of structure, analysis, internal defects, case depth and plating thickness, assuming adequate instrument sensitivity and versatility. And because magnetic analysis will determine the desired information rapidly and accurately, appropriate nondestructive tests can be used for sorting mixed lots of materials or parts, and for control of heat-treating and other processes. The use of magnetic analysis in process control is probably the more important. It may indicate faults and defects in plant methods unsuspected by responsible personnel.

There are several kinds of magnetic-analysis equipment, but it is convenient to divide them into two categories: (1) bar and tube checkers and (2) manufactured-parts inspection equipment.



Steel mills check bars and tubing for internal defects by the magnetic analysis method, but some producers of quality goods employ these units for a rough inspection of incoming material in order to avoid machining stock that later proves defective

BAR AND TUBE CHECKERS

Most bar and tube checking machines are installed in steel mills for discovery of internal defects such as seams, cracks and cupping. Manufacturers of quality goods generally prefer that the mills make the test, because of the leasing expense for the equipment, unless their production is high or their requirements are too exacting for the mills to observe in the time available.

As used in metal-working plants there is little conflict between bar and tube checkers and magnetic-particle inspection. The former are most used in rough inspection to find defects, sort mixed stock, detect under-annealing to avoid tool breakage at automatics.

The machine built by the Magnetic Analysis Corp., passes bar stock or tubing through a magnetic head, or coil, at speeds up to 100 ft. per min. The head consists of primary and secondary windings. Introduction of the bar or tube distorts the sine wave of the voltage induced in the secondary winding. The altered wave form can be seen on an oscilloscope. The instrument is set up to a standard piece. Then if production pieces differ from the standard, the variation in their magnetic properties will cause certain points on the distorted sine curve to shift. If one meter shows an indication, the material contains a crack, seam or lap; if a second meter reads other than zero, the material varies from standard in respect to analysis, grade, or heat-treatment.

When Flux Changes

The defect must not be less than 0.012 in. deep to be discovered. Maximum size of stock handled is 4 in.

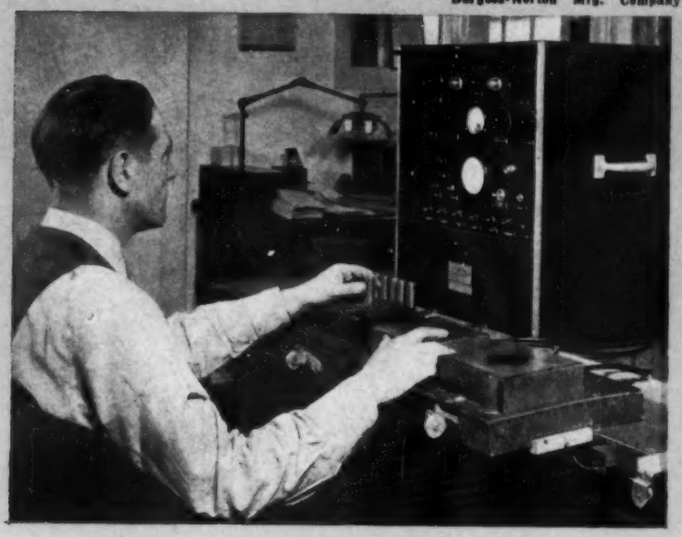
The Sperry electric detector works somewhat differently. As the bar stock or tubing passes through the magnetic head, a current path about 1 ft. long is induced in the material. This current sets up a flux field which is constant so long as there is no change in cross-section such as occurs at a discontinuity. When the flux changes, a searching unit in the detector coil sends a signal to the electronic cabinet and a warning light is lit and the machine is stopped.

The machine handles tubing and bar stock in ferrous and non-ferrous metals, also lead sheath, at speeds up to 120 ft. per min. Seams, splits, laminations, inclusions, cupping, cracks, blisters and dents are discovered. Surface and subsurface defects which extend to within 1/16 in. of the surface are indicated for size and location.

Process control, especially heat-treating, is the primary function of the Cyclograph. Another use is the salvage of mixed parts, by hand or with automatic feeding devices

In piston-pin manufacture, test batches are periodically checked 100% for off-case conditions by this Magnetic Analysis production-type parts comparator. The operation of the carburizing furnaces is thus kept under control

Burgess-Norton Mfg. Company



MACHINED-PARTS ANALYSIS

Comparator-type equipment is used for the magnetic analysis of machined parts. Here the purpose is to compare a test piece with a standard. For any possible condition of the product—for example, shallow case, heavy case, a case on the I.D. in addition to the O.D.—there will be a corresponding indication on the oscilloscope screen. The indication actually present on the screen is compared with the catalogued indications and the part sorted according to its ascertained condition. The results of a batch inspection may then determine measures to be taken in the heat-treating department.

THE CYCLOGRAPH

Magnetic-analysis equipment operating at a single frequency or only within a limited frequency range is not capable of giving complete information about several variable properties of a group of metal parts. Therefore, the Cyclograph is built to operate at frequencies from 2,000 to 200,000 cycles per sec., making it capable of performing multiple tests upon both ferrous and non-ferrous materials. Such tests, singly, or together, are of value in controlling manufacture of mass-production items: especially bolts, screw-machine products, springs, bushings and other components which are more or less symmetrical.

Tests Performed — All tests are based on two fundamentals:

1. A change in structure which results in a significant change in physical properties will produce some change in the magnetic and electrical properties of a metal part.

2. Any distortion in the crystal lattice of a metal produces some effect on the magnetic and electrical properties.

By reason of the first premise, it is possible with the Cyclograph to determine variations in analysis and heat-treatment. All of the commonly used engineering and tool steels can be readily distinguished. Mixed analyses can be separated. For example, several hundred thousand bolts of SAE 4032 and SAE 4037 were successfully sorted, although separation of such close analyses is not generally recommended. On other mixed material of low intrinsic worth, the Cyclograph avoided scrapping the parts because special feeders could be operated at sorting rates of 280 pieces per min.

With the Cyclograph it is possible to accept metal parts within specified hardness limits if extraneous variables are reasonably constant.

Internal stresses set up during quenching or cold working can be compared with a standard. Abnormally high stresses that would cause early failure or cracking are thus found. Stress levels in shot-peened parts can be investigated.

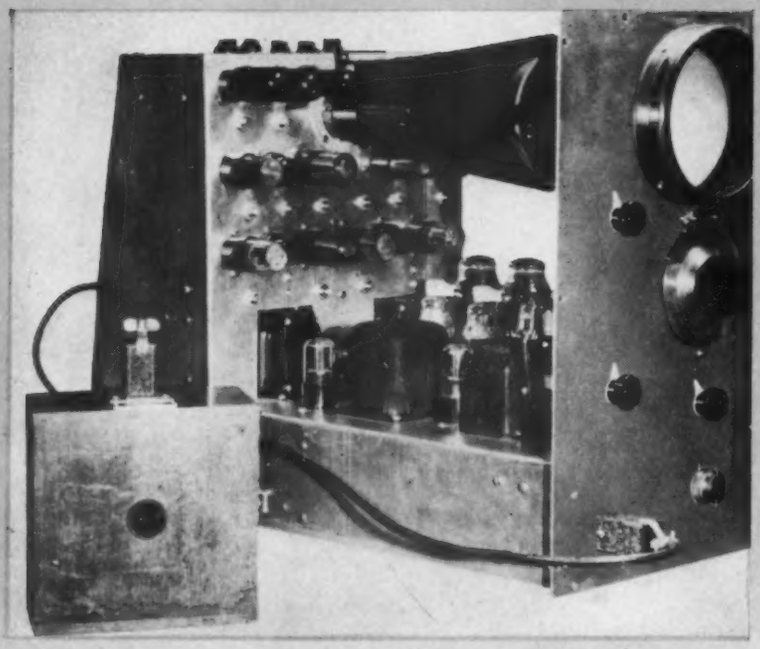
Near-surface variations in structure can be investigated as follows: (a) plating thicknesses can be determined within ±10%, and (b) case depth from 0.010 to 0.040 in. within a few thousandths.

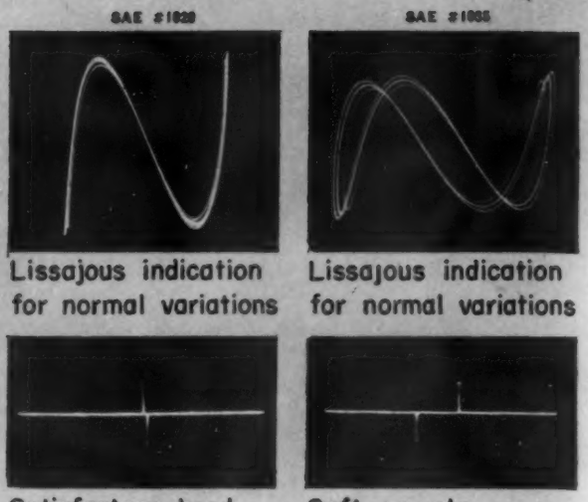
Principle of Operation — Fundamentally, the Cyclograph consists of a two-stage oscillator. The test coil, which is part of the tuned circuit, controls the operating frequency of the oscillator. Core losses occurring in the field of the test coil decrease the oscillator output. This output is viewed on a cathode-ray tube screen. Variations in the amplitude of the indication on the screen are related to the degree of core loss.

Limitations—The Cyclograph does not reveal cracks and surface discontinuities. The equipment is versatile; therefore, it is more complicated than other types.

MAGNETIC ANALYSIS COMPARATOR

The production comparator built by the Magnetic Analysis Corporation operates at a lower frequency range than the preceding instrument. Two coils are used: one for the standard, the other for the test piece. An unskilled worker places the production part vertically in the appropriate coil, notes the oscilloscope pattern and accepts or rejects pieces according to differences from standard





By throwing switches, the Ferrograph provides a Lissajous indication (upper right) to segregate steels, or a line indication with pips (lower right) to show whether the material is properly hardened

in respect to: (1) chemical composition, (2) heat-treatment, hardness and structure, (3) size and shape, (4) mechanical processing, and (5) internal stresses. Castings, forgings, stampings, semi-finished and finished parts can be checked. Surface defects are not checked.

Principle of Operation — Insertion of material in a coil causes distortion of the sine wave of voltage in the secondary. If one-half the sine wave for the standard part is placed in opposition to one-half the sine wave for the test piece, the trace on the oscilloscope should be a straight line. If instead there is a definite pattern, it is compared with catalogued patterns for various product conditions, and thus the condition of the test piece is ascertained.

Coils with inside diameters of ½ to 6 in. can be used. The work must be of uniform cross-section, but may be round, square, hexagonal or H-shaped, if desired.

THE FERROGRAPH

A fixed low frequency of 26 cycles is used in the Ferrograph, which is designed for hand sorting of ferrous parts. The use of a low frequency in this instrument is based upon the fact that an appreciable effect is obtained from remanent magnetism. The principle of operation is based on harmonic analysis of the induced voltage in the secondary of the test transformer in which the sample is made the core. Two selectable indications can be analyzed: first, a Lissajous pattern which is usually related to analysis of the material, and second, a straight line pattern with pips which may be used to ascertain such matters as hardness or softness of the material.

In general, the Ferrograph may be considered a sorting instrument. Some of the practical applications have been:

By using the proper sensitivity, steel bars were sorted so that those below Rockwell C 32 were rejected.

Steel bolts of different analysis were mixed, then heat-treated, after which the error was discovered. The bolts made of lower carbon steel were too soft for use. Separation by hardness testing was impractical, but was done at the rate of one per second on the Ferrograph. Differences in amplitude of the Lissajous patterns was sufficient to distinguish between grades, although the difference in hardness was about 15 points.

Several hundred thousand case-hardened pins contained a percentage that did not meet specifications for core hardness. The surface hardness was satisfactory; it was impossible to segregate the pins by hardness testing. Satisfactory pins, with a range from 32 to 38 Rockwell C, were successfully separated from pins with a core hardness above and below this range. The operation was done with the second type of indication, and using sufficient sensitivity to pick out slight differences in phase relations.

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Magnaflux Corporation
Magnetic Analysis Corporation
North American Phillips Company
Northrop Aircraft, Inc.
Shell Oil Company
Sperry Products, Inc.
The Texas Company
Sam Tour, Inc.
Westinghouse Electric Corporation

HOUSING CAN COST TOO MUCH

EVERYONE in the United States wants our people, and particularly our war veterans, well housed quickly. Almost everyone, we believe, likes the vigor and imagination with which Wilson W. Wyatt, the housing expediter, is going about the job of mobilizing our housing resources.

No one, however, wants the veterans, or anyone else, to get a lot of severe economic headaches along with the housing. As it stands, the emergency housing program runs unnecessary risks of having such results.

Here are the reasons:

1. The principal opportunity the program offers to the veteran is that of buying a high-cost house where a chance to rent would, more often than not, meet his needs much better.

2. At the worst possible time, the program adds substantially to the dangers of a runaway inflation of the sort that inevitably ends in a crash.

3. Little is done to try to reduce the arbitrarily high costs of building, such as those resulting from restrictions imposed by labor unions and antiquated building codes.

4. By giving overriding priorities to unattainable goals of home construction, the program endangers a volume of industrial construction necessary to sustain full employment.

Needs of Veterans

First on the needs of the veterans. What many, if not most, veterans need is a chance to rent a place at a reasonable rental while they are getting shaken down in their postwar careers which in many cases are inevitably unsettled at this time. Essentially, what the "Veterans Emergency Housing Program" gives them is a chance to buy, for about $6,000, a house built along conventional lines and padded with much unnecessary labor and material cost.

But what are the alternatives? There are at least two. One is to put far more emphasis on more effective use of existing housing than the Wyatt program has thus far. The other is to see that the proportion of new rental units is much stepped up.

Incredible as it may seem, there are at present more than 2,000,000 vacant dwellings in the United States. Many of them should be demolished. But many permit of relatively satisfactory temporary use. Many more single dwellings can readily be converted into comfortable multiple dwellings. The emergency program assumes that only 350,000 dwelling units can be provided this year by these expedients, but it does not seem unreasonable to assume that this figure might be doubled by a vigorous drive. The result would be a better balanced emergency housing program, because it would provide more rental housing immediately and save critical building materials.

Of the new housing units contemplated by the Wyatt program, it is estimated that only about 20 per cent will be for rent. Before the war more than half of the homes in the United States were rented. That means that unless the Wyatt program is to create little less than a revolution in the terms on which homes are occupied, it must be revised to include a much higher proportion of rental units.

To secure the result in the face of present high building costs special inducements will be required. They might be provided by allowing accelerated tax amortization of, say, half the construction cost over the next five years, together with rent ceilings high enough to make this form of investment attractive. This would, of course, call for higher rents, but the actual price to the veteran, in woe as well as money, might well be much less in the long run than if he bought an over-priced house now.

Too Easy To Pay Too Much

One of the mysteries of the Wyatt program is its general emphasis on measures to increase the supply of money with which to buy houses when the demand for houses is already at an all-time high. Some veterans may need special financial help, but the plan to give 90-95 per cent mortgages generally on new homes is not only unnecessary but positively dangerous. By providing up to $3.5 billions of government-guaranteed credit for homes this year, and almost twice as much in 1947, the program will release an equivalent amount of individual savings to create further demand for goods and services. All that such generous mortgage terms will accomplish with certainty is a dangerous lengthening of the odds that we will not avoid a boom and bust cycle of inflation.

If building codes were brought up to date and arbitrary union working restrictions were eliminated, the way would be paved for reductions in the price of standard houses which, it has been estimated, might run as much as 20 per cent. This would both give the buyer of a new house a far better run for his money, and also reduce the inflationary pressure created by the super-generous credit arrangements involved.

Getting anything done along this line is difficult, particularly because the restrictions are imposed by tens of thousands of separate localities and organizations. Some headway is being made. The local emergency housing committees being set up under the Wyatt program provide a means of doing much more. Far more steam must be put behind this aspect of the program, however, if its greatest potentiality for permanently constructive accomplishment is to be realized.

Crippling Essential Industrial Production

The goals set for emergency housing construction —1,200,000 new homes started this year and 1,500,000 started in 1947—are higher than any qualified authority thinks can be met without crippling other essential construction. The reasons commonly assigned for such optimistic goals is that they are inspiring to those in the industry and soothing to those who want something tremendous done about housing.

Under normal circumstances, relatively little damage might be done by such excessive goals which are a common feature of most Washington programs trying to elbow their way to the center of the national stage. However, the emergency housing program carries with it top priorities for the materials to be used. Consequently, other essential construction will have to get along on whatever share of critical building materials will be left after all demands of home builders have been satisfied.

The Civilian Production Administration estimates that output of important materials will fall far short of needs. It forecasts a 15 per cent deficit in lumber, 18 per cent in bricks, and 52 per cent in cast iron radiators. Hence, unless building materials output can be stepped up far more rapidly than now seems possible, a prohibitive squeeze will be put on industrial building to provide the materials needed for the Wyatt program. This would complicate unbearably the problems of sustaining full employment and getting the flow of production so important in avoiding the boom and bust route.

Perspective on the Housing Shortage

What is needed is an aggressive drive to get full production of building materials as rapidly as possible. Such a drive should concentrate on measures aimed at helping the industry remove the obstacles to all-out production rather than on such measures as the subsidy plan which seems quite likely to succeed only in enmeshing the industry in more government controls. After making due allowance for the materials outlook and the needs for essential non-housing construction, housing goals should then be set as high as feasible. As matters stand, by setting construction goals before feasible material goals are determined, the cart is put before the horse.

There can be no doubt about the acuteness of the housing shortage and the necessity of a program commensurate with the magnitude of the problem. It also remains true, however, that the housing shortage for the nation as a whole is not quite as desperate as those who want the country to drop everything and go to building houses would have us believe.

During the war 3½ to 4 million new dwelling units were built or created by remodelling in other than farm areas. The number of families living in such areas increased by less than 3½ million. Even though some of this housing was located in remote places as an adjunct of war production works, the wartime increase permitted a margin for more housing per family at this time. Indeed, it has been estimated that the rate of doubling up is only about one-third as great as in 1940. The margin did not begin to suffice, however, to meet the needs of those millions of people particularly in the lower income groups who, thanks to rapid increases in income, can afford to have and insist upon having better housing than they have ever had before.

A rising standard of income which makes possible a new standard of housing for many people is a fine thing. Above all, it is important to see the veterans get the best possible break in housing.

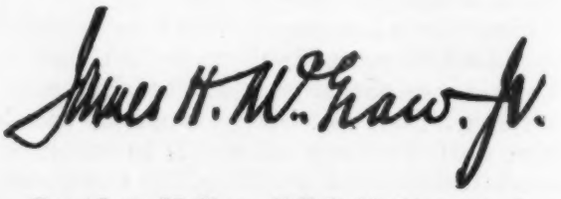
But Housing Can Cost Too Much

The Wyatt program has many good features. The emphasis on prefabrication, though perhaps overoptimistic, is hopefully modern. The emphasis on local collaboration in solving housing problems which are inevitably in large part local should lead to permanently valuable results. The vigorous mobilizing of 300,000 temporary dwellings to meet at high speed some of the most desperate shortage is all to the good.

The main trouble with the program is that it does not pay enough attention to the economic havoc which may be created in the process of trying to meet its excessive goals. As a nation, we should be and are willing to pay a high price to get adequate housing. But the price will be too high if we:

1. Give the veteran a bad bargain by selling him an over-priced house.
2. Cripple industrial production needed to create good jobs for veterans, and
3. Touch off a disastrous inflationary sequence in the process.

These pitfalls can be avoided. All of us, including the veterans, have a common interest in seeing that they are avoided.



President, McGraw-Hill Publishing Co., Inc.

More About Radial Chaser Sharpening

BY H. SCHLARMAN

Continuing the discussion of bearing and some other phases of sharpening, the author points out precautions to be observed

LAST installment of this series told how to sharpen radial chasers and of the need, in sharpening, to obtain the correct bearing. The subject of bearing is so vital to the cutting of clean threads that it merits further examination.

Conditions of light and heavy bearing, how to recognize the troubles, and how to correct them are:

When the bearing is not enough above center, it is referred to as *light bearing.*

When the bearing is too much above center it is referred to as *heavy bearing.*

Light Bearing:

There can be three conditions of light bearing.

(a) of the chamfer only
(b) of the step only
(c)—(a) and (b) together

Indicators of Condition (a):

1. Chattered or flaky-looking thread finish.
2. Wide thread root.

Indicators of Condition (b):

1. Same as (a) 1 and 2.
2. The full teeth back of the chamfer will show a "frost" on the flanks where they have been shaving or side trimming. See Fig. 29

Corrective measures for light bearing.

1. If chaser teeth show side trimming or shaving they will have to be honed where the "frost" shows.
2. Correct chamfer clearance angle according to the calculated chamfer clearance angle for the step height above the die center.

Heavy Bearing:

There can be three conditions of heavy bearing:

(a) of the chamfer only
(b) of the step only
(c)—(a) and (b) together

If the cutting action of a chaser is not right and the chaser shows no signs of light bearing, the chances are that it has a heavy bearing.

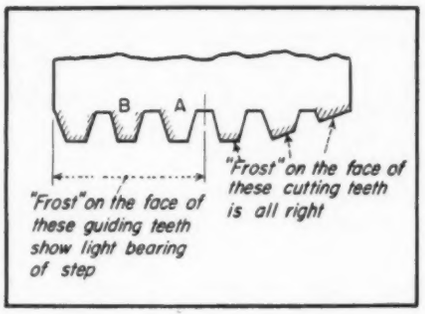

B
A
"Frost" on the face of these guiding teeth show light bearing of step
"Frost" on the face of these cutting teeth is all right

Fig. 29—The "frosted" condition of the trailing flank of a tooth *A* indicates "side trimming." Frosting as on tooth *B* is called "shaving." *A* and *B* are the result of light bearing

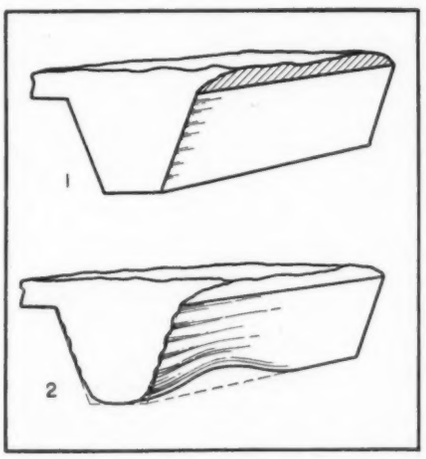


Fig. 30—Ridges in tooth flanks and the crests of teeth worn to a radius are caused by heavy bearing

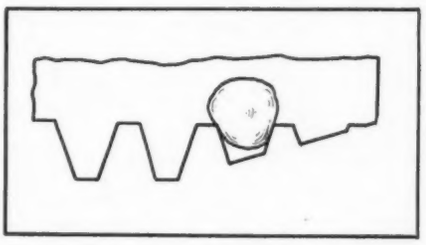


Fig 31—Another indication of heavy bearing is flaking of the teeth on the step at the chamfer

Indicators of Heavy Bearing.

1. In acute cases of heavy bearing, especially on very coarse pitches, the chasers may squeal under cut.
2. Hard starting.
3. Ridges worn in flanks of teeth, rounded tooth form, excessive wear on chamfer cutting teeth. See Fig. 30. When the chaser teeth are worn to condition shown in (1) the chasers are almost useless. When they are so bad as in (2) the chasers are junk.
4. Breakage of teeth.
5. Flaking of step at chamfer. Fig. 31.
6. Rough threads.

A new chaser may have heavy bearing due either to the bearing of the chaser teeth or chamfer, or a combination of both.

Squealing is not much help as an indicator on the average run of work. Although it is a sure indication of heavy bearing, it happens only on very coarse pitches when the bearing is extremely heavy.

Probably the best indicator of heavy bearing is "hard start." It takes little pressure, behind the die, to start chasers cutting if the bearing is right. Unfortunately, starting pressure is something that cannot be put into words but is a "feel" that must be acquired through experience. The experienced man can tell when a chaser starts hard.

Indicator 3 is a sure sign of heavy bearing. If the operator stops using the chasers before these ridges appear, the chasers will probably be reconditionable. However, if the operator runs the chasers until these ridges appear, the chasers are well on their way to the junk heap.

Chasers, if attention is paid, give warning of approaching heavy bearing. They will start harder, the thread finish will become increasingly rough, and the thread fit will become bothersome.

Heavy bearing will cause breakage of teeth and flaking of chamfer. However, other factors such as hitting the shoulder, too hard a chaser, too high a work speed, incorrect heat-treatment and misalignment are all contributing causes of breakage. These causes can be checked and eliminated until the correct cause is found.

Chasers producing rough threads sooner than they should is an indication of heavy bearing. Sometimes the frequent chipping of the point of the first full tooth is also an indication of heavy bearing.

A helpful way of tracking down heavy bearing is comparison with past performance. A job that has been run before gives a fairly good idea of how long the chasers should run to a grind, how they start, and what thread finish was produced. Comparisons between the troublesome chasers and the chasers that worked all right in service give a great deal of information.

It must be remembered that chasing down thread trouble is a process of elimination. First, all the factors that might cause the trouble must be known. Then they must be checked one by one until the cause or causes of the trouble appear.

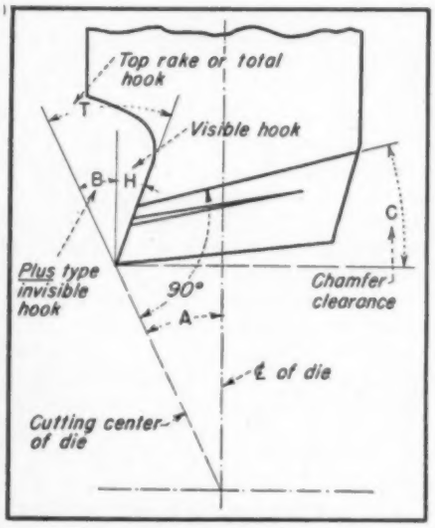


Fig. 32—This sketch shows the factors of visible and "plus type" invisible hook that determine top rake

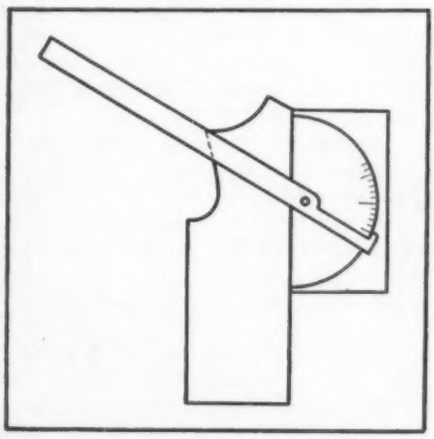


Fig. 34—An approximation of the chamfer clearance angle on hobbed chasers may be obtained with a protractor

Corrections for Heavy Bearing:

If you suspect chasers of having heavy bearing, first check and correct the chamfer clearance angle to the calculated angle. Then test the chaser by cutting a few threads. If there is still evidence of heavy bearing, it shows the step is too much above center. Grind the step down 0.002 or 0.003 in. and test again. Repeat until the evidence of heavy bearing disappears. Then recalculate the chamfer clearance angle for the new height of step above center.

The importance of a sound basic understanding of clearance angles and bearings in the intelligent handling of radial dies is evident from the above discussion.

Top Rake

Not too many shop men understand the computations that go into the maintenance of top rake. Top rake is total hook. Total hook includes "visible" and "invisible" hook.

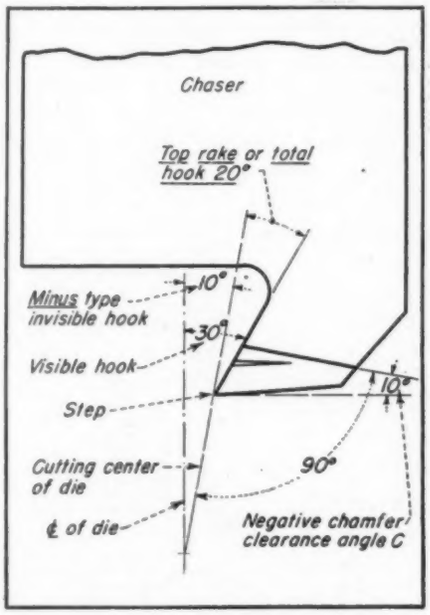


Fig. 33—Top rake is equal to the visible hook minus the chamfer clearance angle, or "minus type" invisible hook, when the step (points of chaser teeth) is below the centerline of the diehead

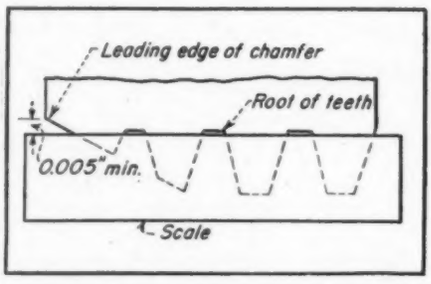


Fig. 35—How to use a scale to check the clearance of the chamfer leading edge above the root line

There are two types of invisible hook. The "plus" type is always found when the step is ahead of the die center and is added to the visible hook to obtain the top rake. The "minus" type is shown in Fig. 33 and always occurs when the step is behind the die center. "Minus" invisible hook is subtracted from the visible hook to produce the top rake.

In Fig. 32, *H* is the visible hook. This can be measured easily with a protractor. Invisible hook *B* cannot be measured with a protractor at *B*. However by trigonometry, angle *B* is equal to angle *A*. We have already shown that the chamfer clearance angle *C* must equal angle *A*. Therefore angle *B* is equal to angle *C*.

It then follows that the top rake or total hook, when the step is ahead of the die center, is equal to the chamfer clearance angle *C* ("plus" invisible hook) added to the visible hook *H*. This shows the further importance of knowing how to calculate the chamfer clearance angle.

Effect of Step

Since the chamfer clearance angle *C* is dependent on the height above center of the step, it is apparent that maintaining the visible hook *H* does not maintain the original top rake if the step is lowered. The lower the step the greater would be the visible hook to maintain the same top rake the chaser had when new.

For example, let us say that we require a 20° top rake for a certain steel. If the chamfer clearance angle on the new chaser is 10°, there will be a 10° hook on the step.

To take an extreme example, let us consider the chasers with the step on the exact center of the diehead. The chamfer clearance angle would be 0°. In order to have 20° top rake, a 20° hook would be required.

If the cutting edge was 10° back of center, the chamfer would require a 10° negative clearance. This would mean that a 30° hook would be required in order to maintain a 20° top rake. It can be seen from this and Fig. 33 that, where the cutting edge is below the die center, top rake is equal to visible hook minus the chamfer clearance angle (invisible hook, "minus" type).

This should never be a condition on cut or milled, ground, or ground and lapped chasers. The step on these types should rarely ever be lowered.

On hobbed chasers, when the user is utilizing the chaser to the last possible bit, this below-center condition

may occur. When it does, the original top rake may have to be decreased or the amount of hook is so great that the cutting edge will chip off quickly because of thin section.

Users of radial chasers should thoroughly understand the foregoing as it is the base for the intelligent handling of any type of radial chaser. The principles governing calculation of chamfer clearance, bearing and top rake are fundamental to the user of any type of radial chaser.

"Don'ts" in Sharpening

Combined with these principles are two big DON'TS:

1. Don't resharpen chasers freehand. Use the grinding fixture to hold the chasers.
2. Don't grind milled-type chasers on the step. Do the resharpening on the chamfer.

If milled, milled and ground, or ground and lapped chasers are not ground on the step it is necessary only to resharpen them with the same chamfer clearance angle as furnished on the new chaser. This chamfer clearance is usually specified in the manufacturer's sharpening instructions, or it can be measured on the new chaser before the first resharpening.

If, however, the step has been ground and, consequently, the point height lowered, the chamfer clearance angle and step hook should be calculated as explained. This is increasingly important on the smaller-diameter threads. Whereas on an 1½-in. diameter thread, a degree or two may not make much difference, half a degree on a number-sized thread may make the difference between the chaser acting like a turning tool or cutting a thread as it should.

On small threads, particularly number-sized, the point of contact between the chaser's chamfer and the stock is so critical, due to the extreme curvature of the stock circumference, that a hair's difference in the chamfer clearance angle makes a great difference in the bearing.

On larger diameters, if the bearing is too light, it usually shows in chatter. However, on number size threads, most of which are cut on B.&S. automatics, light bearing shows in the stock being turned instead of threaded or in a thread having a wide groove and a very thin tooth.

A slight decrease in clearance resulting in a sightly heavier bearing may correct this. If the bearing is too heavy, the chasers will start hard and produce a torn thread.

Hobbed or Tapped Chasers

These chasers are not in too common use. They are used by some for close-shoulder work where the chamfer may not be resharpened and when it is desired to grind the step for resharpening.

The hobbed chaser is designed with the chaser tooth as well as the chamfer clearance having a curve from the step to the heel. This curve is supposed to be such that approximately the original clearances are maintained even though the chasers are ground on the step.

This would seem like an ideal setup, but it does not work so well in practice. Very often these curvatures are not correct, particularly in the chamfer clearance. The chamfer clearance is ground, of course, after the chaser is complete. If the chamfer clearance radius or its center, with relation to the die center, is not exactly right, a too light or too heavy cutting bearing results.

This happens more often than not in the user's shop when the attempt is made to resharpen the chamfer. The usual method of resharpening is to use a thin rubber wheel set at an angle to generate a curve. To set this wheel at an angle (this will vary with the size of the wheel) to produce the proper curve, and to locate the center of this curve in proper relation to the cutting edge to produce the correct clearance, is not the easiest thing to do.

Another drawback is that there is so much contact, because of the curvature, between the chaser teeth and the thread cut, that heavy bearing is produced far more quickly than on a milled-type tooth. A curvature that may give a reasonable run on mild steel may have so much "hugging" action it will cause heavy bearing in a short while on tough material.

Heavy bearing, of course, means frequent resharpening and often broken teeth. This "hugging" action is sometimes used to advantage in threading over cotter-pin holes where it helps steady the cutting edge while passing over the hole.

Although it is claimed that hobbed chasers can be ground on the step, it cannot be done without paying the same penalties that accrue when grinding any radial chaser that way. Grinding on the step invariably lightens the bearing and results in cutting by the back teeth of the chaser. This causes taper, off lead, poor form, drunkenness and off-center threads.

If the reader thoroughly understood the preceding article of this series, on milled and ground chasers, he will understand the material concerning hobbed chasers as the principles are exactly the same. When resharpening hobbed chasers by grinding on the

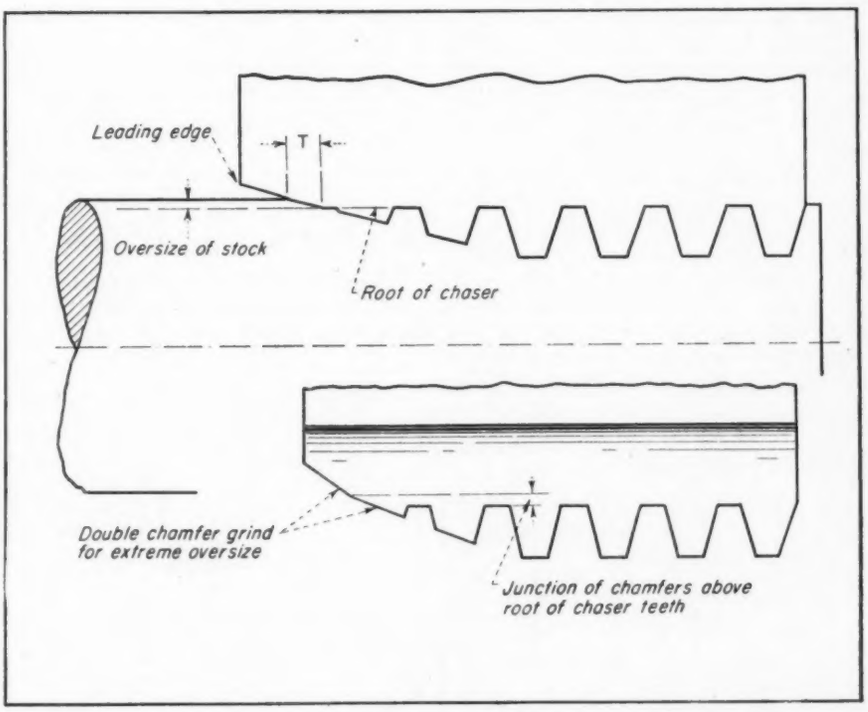


Fig. 36—In threading oversize stock the chamfer should be ground deep enough to clear it. A double chamfer is useful in extreme cases

step, the amount of hook required to maintain the original top rake changes rapidly since a 0.020 or 0.030-in. grind may be necessary to remove the wear on the teeth. It is, therefore, advisable to check both the chamfer clearance angle and top rake by calculation.

Grinding the step at a ½ to 1° angle so that the rear teeth are more above center than the front helps. This allows the removal of the wear on the chamfer but leaves a little of the worn bearing on the back teeth to help guide and prevent side trimming. If the chasers have been run so dull as to have worn in a heavy bearing as shown in Fig. 30, then all the bearing will have to be removed. On the angle step grind, the step height is measured directly back of the first full tooth for chamfer clearance and top rake calculations. This should, of course, be done after the step has been reground.

The radius type of chamfer clearance angle can be measured fairly close with a protractor, as shown in Fig. 34. The same straight chamfer clearance angle, as used on the milled type, can be used on hobbed chasers in cases where extreme trouble is experienced with the radius grind.

Taper Chasers

Unless the diehead is of the receding type—that is, opens up on the taper—the chasers are what are called "plunge cut" chasers. This means that, unlike the straight chaser, all the teeth on a taper chaser cut.

This is the type generally used because taper threading is a very small part of the work done in the average screw shop. Therefore, it does not pay to have a receding head.

The plunge-cut taper chaser should be resharpened as much as possible on the chamfer just like the straight chaser. However, the taper chaser can be ground on the chamfer only to a point where the distance from the first tooth to the last is two or three threads longer than the length of the pipe thread itself. If the distance from the first full tooth to the last chaser tooth is shorter, a pipe thread will be produced having the first few threads straight and the rest tapered, because the chaser will be narrower than the length of the standard taper pipe thread.

If the step is ground, theoretically, it should be ground with a slight reverse taper so that the rear teeth will be slightly nearer center than the front teeth. This is because the teeth toward the back are cutting smaller diameters.

Although the parallel step grind will be found to work sufficiently well, the chasers have a better chance of giving a good thread and running longer if the reverse step grind is used, particularly where the blank has not been formed to the taper.

On standard ¾ in. per foot taper threads, the following reverse step grinds can be used: from ¼- to ¾-in. pipe threads, approximtely ½°; from ¾- to 1½-in., approximately ¾°; from 1½- to 3-in. approximately 1¼°.

Where taper chasers are used in a receding head, the chasers should be ground on the chamfer only, just as straight chasers are.

The conclusion should not be drawn that a taper chaser can be step-ground carelessly or as much as desired. Only enough should be ground to lighten the bearing or dullness, caused by the previous run, to allow the chaser to cut. Grinding too much off the step on a taper chaser will cause it to chatter just as it would on a straight chaser.

The same method of calculating chamfer clearance and top rake is used on taper chasers as on straight. The step height and root radius on taper chasers is measured and calculated at the first full tooth.

Grinding the Chamfer Angle

The chamfer angle of radial chasers can be easily changed to suit the job. However, it has been found that carelessness or ignorance of how this should be done has caused trouble, particularly on close-to-shoulder jobs.

The leading edge of the chamfer should be at least 0.005 in. above the root of the chaser teeth on any chamfered chasers. Short chamfered chasers should be kept at no less than 0.005 in. but not a great deal more. Where there is no shoulder on the thread, the leading chamfer edge can be 0.005 in. plus. Whether or not the leading chamfer edge is above the root of the teeth can be checked by laying a scale along the roots of the teeth and sighting as in Fig. 35.

Fig. 36 shows how chamfer should be ground for oversize stock where conditions are such that the stock cannot be turned down. The chamfer should be ground deeply enough so the leading edge more than clears the outside diameter of the stock. In this way the chamfer helps turn down the stock (see T) somewhere near the proper outside diameter before the thread is formed. Fig. 36 also shows the double-chamfer grind sometimes used for extreme cases of oversize stock. The same clearance angle is used on both chamfers.

Close-to-Shoulder Sharpening

To resharpen radial chasers for close-to-shoulder work, put the chasers in the diehead, lock the head, and screw the sample into the chasers. Then trace the shoulder circumference on the chaser as in Fig. 37*A*. If the diehead used has a front cover, giving support to the chaser, unlock the head and check if the shoulder mark on the chaser is still visible. The opening throw of the head may pull the mark up under the front supporting plate. If so, always check to see if there is enough surface left on the chaser for the front plate to support.

Then, by measuring one chaser against the other, pick out the chaser that has the first full tooth farthest in from the leading edge of the chamfer. Refer to this chaser as *X*.

Line all the chasers up from the

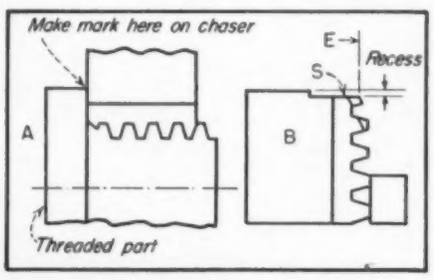


Fig. 37—Recess before rechamfering for close to shoulder work

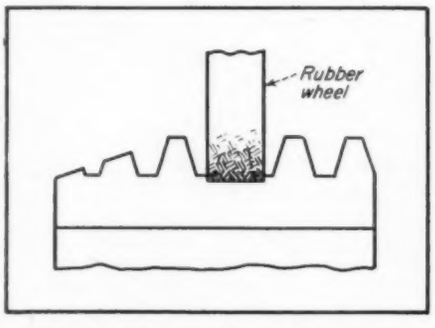


Fig. 38—Broken teeth can be removed with a thin rubber-bonded wheel

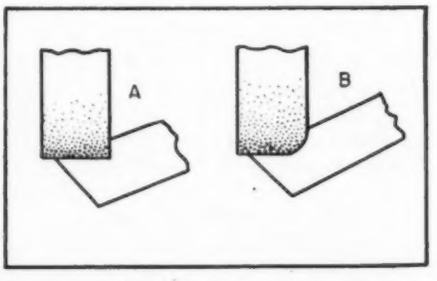


Fig. 39—A square corner *A* should be avoided in grinding hook; *B* is correct

crest of the chaser teeth on a surface grinder and grind the recess (Fig. 37*B*). Leave chaser *X* in the outside position so that it can be used to check the depth of the recess grind.

The depth of the recess should be ground to as little as possible to save the chaser life. This depends on the condition of the chaser as well as on the difference between the original chamfer and the required new chamfer. If worn excessively dull, or if the chamfer has a broken tooth, it may be necessary to grind the recess deep enough to clean up the first full tooth.

After the recess is ground the chaser should be rechamfered. Never rechamfer first and grind the recess afterwards. This usually results in having to regrind the chamfer again because the leading chamfer edge is at *E* (below the root of the chaser teeth) when it should be at *S* (above the root of the chaser teeth).

A thin rubber wheel, less than one pitch in thickness, is used to remove broken teeth. See Fig. 38.

It has been stated before but is worth repeating again: Don't grind any radial chaser on the step any more than absolutely necessary. Many of the troubles experienced by radial-chaser users can be traced to needless and excessive step-grinding. Dubbed chaser points or heavy bearing are the only valid reason for lowering the step. Care should be taken not to lower the step more than 0.002 or 0.003 in. at a time before the chasers are checked.

Grinding Hook on Radial Chasers

Hook can be ground on brass-cutting chasers without lowering the step because brass chasers have negative hook to start wtih. However, only more hook can be ground on a steel-cutting chaser. Attempting to grind less hook than the original, results in lowering the step, which causes many troubles as explained previously.

Never grind hook with a square-cornered wheel, as shown in Fig. 39*A*. Radius the corner of the wheel as shown in Fig. 39*B*. A square corner does not allow the chips to flow out smoothly. It has a tendency to dam up the chips and may cause rough threads, particularly on the coarser pitches. It may also help cause breakage. When changing hook, grind just deep enough to clean up the tips of the chaser teeth.

The purpose of the shear-cut grind on the chamfer is to get a lot of hook on the cutting edge without weakening all the non-cutting teeth. Shear cut is also used to curl the chip out front and prevent it from packing up in the die. It is often a great help when the thread diameter is near the maximum of the die capacity and the pitch is coarse. If the thread is of any length, the chips may pack up between the stock and die, because of insufficient clearance, and cause torn threads and chaser breakage. A chamfer shear-cut grind will often relieve this condition.

Shear cut should be ground with as small a wheel as available. The side of the wheel C' should be parallel to the chamfer cutting edge *C* and also the edge of the wheel *S'* should be parallel to the flat step surfaces *S* to produce the shear cut, as shown in Fig. 40.

The shear-cut grind is an advantage when a lot of hook is required. It allows a lot of hook to be ground on the chamfer cutting edge where it is needed but does not affect the rest of the chaser teeth. If a lot of hook is ground the full length of the step, it weakens the points of the guiding teeth and they are likely to chip and spoil the chasers.

Honing

A good rule is: Don't hone. Honing is like taking dope. For a while it relieves, then it has to be used until it destroys.

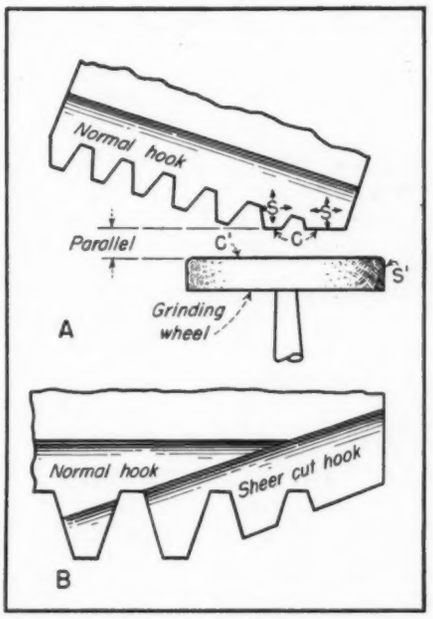


Fig. 40—Shear cut is ground by positioning the chaser so the wheel is parallel to the cutting edge C and the flat step surfaces of the chamfer angle. The full length of the chamfer then comes to a sharp edge without reducing the chamfer bearing

Some of the chaser life is lost the moment a hone touches a chaser. Also the more a chaser is honed, the more it needs to be honed, the quicker the chaser is used up, and the harder it is to recondition so it will cut.

There is absolutely no excuse for using a hone on either tangent or circular chasers. The purpose of honing on these types is accomplished by proper sharpening.

Honing is sometimes inescapable on the radial plain milled-only, ground-only, or hobbed chasers because the controlling back teeth cut. This is because the step height was too low originally, or because it was ground down by the user.

Don't hone unless it is absolutely necessary. When it is necessary, use the hone very carefully and as little as possible.

The purpose of honing is to relieve the edges of the controlling teeth so that they will not cut. Never hone the chamfer cutting teeth on the flanks. If more bearing is required, or in other words, a heavier chamfer cutting action, decrease the chamfer clearance angle.

A fine-grade 60° three-cornered or a knife-edge oilstone should be used for honing. The three-cornered stone is easier to handle properly. However, it is not so good as the knife-edge type for fine pitches, because the points are not sharp enough, or they break down so it is impossible to contact the full depth of the flank.

Always use that part of the hone having a sharp edge and straight smooth sides. If the corner is rounded and the sides rough and uneven, the honed edge will be the same way.

The proper way to use a hone is:

First lay the hone in the thread. Then, letting the hone contact the edge of the teeth at the step, lift the back end of the hone a very little. Take a short stroke forward towards the step with a very light pressure toward the flank to be honed. Repeat this as required. Do not run the hone back and forth, as the guiding action of the teeth will be lost and an uneven and heavy honing action will result.

When using a 60° hone, be especially careful not to lift the back end of the hone too much, as the result will be a heavy hone near the point of the teeth, tapering to almost nothing at the root. This is caused by the fact that the hone remains 60° at any angle, but the thread form on the face of the lip is actually less than 60° because of the hook.

ROUND TABLE

How Much Should Men Be Told?

"WHEN fiber board is so scarce, what's the big idea of sticking a whole panel up here, Al?" Ed was pointing to a new decoration behind Al's desk.

"Don't be so sarcastic, Pop. You know darn well it's a bulletin board. I've had a theory for a long time that telling boys what's going on will help out, and the Old Man has agreed to let me try it. If it works out here, it goes in other departments. So you'd better start picking a nice easy-to-read place in the toolroom—with room enough in front so you can back off to get a look through your specs."

"That's what you think, young feller. Whether or not, you finagle some gadget like that onto the wall, I'll still tell my boys as much as I think they need to know. If I have to use the board, I can use it to stick up some of the papers I ain't got a place for now."

"But, Ed, you sound like you think that letting everybody know what's going on is a silly idea. Don't you think that telling the men where the stuff they're making goes and what it does, what costs are and the rest of it makes them feel they're doing something worthwhile?"

"Sometimes you talk like a schoolgirl, Al. You sound like some of those pepper-uppers that used to come around during the War. They used to be so full of 'let's work together' and general sweetness and light they made me a little sick to my stomach."

"Just a big, tough, tobacco-chewing, shop man, aren't you, Ed? Afraid to show any normal feelings because somebody will think you're soft. And afraid to tell the boys what's going on for fear they'll know as much as you do about company business."

"Don't kid yourself—I'm not afraid. I just don't see any point in spreading company business to every palooka in the place. All you do is satisfy prying curiosity and make it easier for competitors to find out what we're up to."

"They find out anyway, Ed, and a lot easier if the boys think you're not trusting 'em. There's nothing that's more fun than telling somebody else's secrets, if you're sure they aren't supposed to be told."

"So you're for making things easier by giving the details, eh? What do you figure on putting up—a play-by-play report on costs?"

"That's about it, Ed. I'd like to show just what the things are we're making and where they fit into the company' products, what each part costs for material, labor, overhead, sales and so on. That'll give the boys an idea of the loss when a piece is junked and of the things that make the difference between cost and sales price. I'd like to get some dope, too, on how our products are working in the field, what customers think of 'em, and so on."

"So you're not only gonna tell everybody all you know; you're gonna have the boys spending half their working days reading all the stuff you put up, eh? Who's gonna spend all the time to get that stuff ready, and who's gonna explain it?"

"I am, Ed, with help from the front office if I get stuck, and I'll bet you now that more of my boys whistle while they work from now on. Wanna bet?"

IS IT PROFITABLE, *in terms of money, morale, or both, to let the men in on company costs, statistics, sales problems, product successes and failures? Is the feeling of confidence worth possible leakage of vital information? Have you any experience or opinions on this subject you'd like to share? Published discussions will be paid for. Discussions of previous topics appear on later pages.*

Practical Ideas

HAVE YOU A PRACTICAL IDEA?... If so, send it in. Your idea will help other men, in other shops, who have a problem similar to yours. We pay for acceptable contributions prepared exclusively for this publication

Two Broaching Fixtures For Special Work

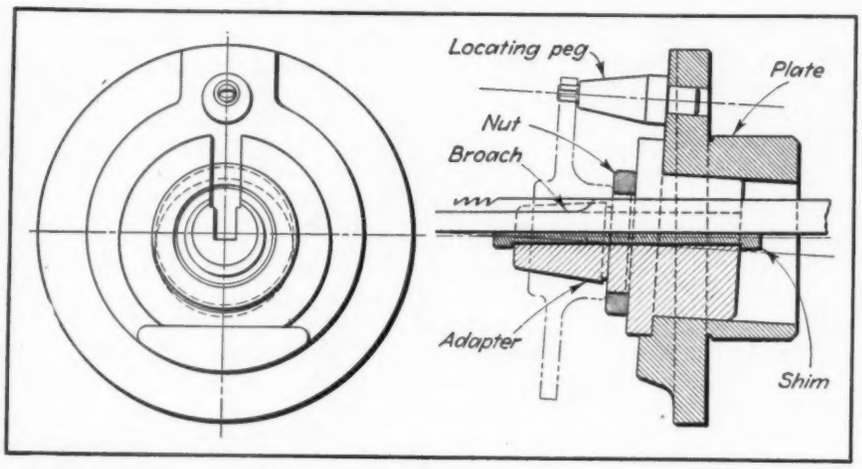
THOMAS A. DICKINSON

Most broaching can be accomplished without special fixtures; a hardened bushing which fits into a hole in a machine table is all that's generally necessary. However, on vertical machines it is sometimes preferable to slide the work over the leading edge of the broach; and, in such cases, fixtures are desirable.

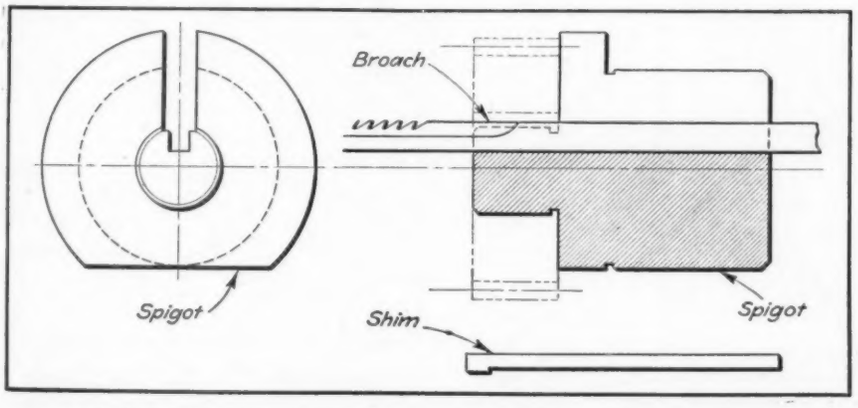
The accompanying illustrations indicate fixtures which have served the latter purpose for Plomb Tool Co., Los Angeles, Calif.

One of the fixtures is used when the bottom of the keyway in a taper hole must be parallel to the taper. A work-locating spigot is arranged with its axis at an angle to the centerline of the tool and broach guide so that the work will be held in the required position. Because the fixture is flanged and increased in diameter, and because a locating peg is provided, the keyway may be positioned radially with respect to the holes in the flange.

The other illustration shows a spigot-type broaching fixture whose rear portion may be fitted into a hole in a machine table, and whose flat undersurface is positioned against a shoulder or plate to prevent movement. A component (represented by phantom lines) is push-fitted over the front end of the fixture, and the bottom of the groove within the fixture controls the depth of the keyway as the total depth of the groove plus the depth of the keyway equals the maximum depth of the broach at its largest end. If a hardened shim is placed in the bottom of the fixture groove, it becomes possible to cut a keyway deeper than the total cutting depth of the broach. A lip on the shim should bear against the end of the spigot and keep the shim from being pulled through the slot by the friction of the broach.



Tapered splines and keyways are broached with this work indexing fixture



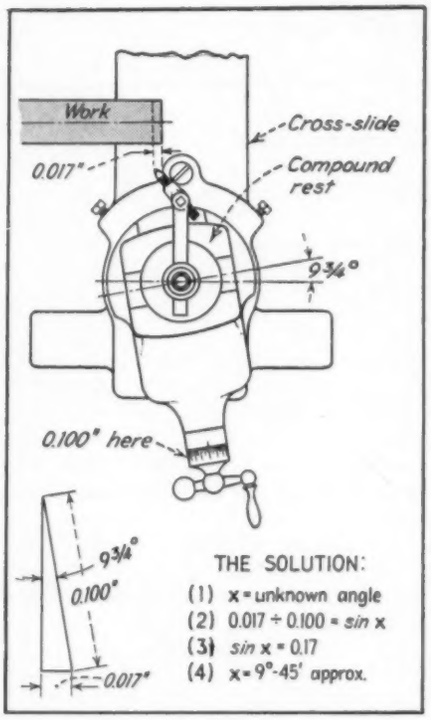
Workpiece is represented in phantom; shim permits deeper cuts

Trigonometry Versus Micrometer Stops In Turning and Facing

DAVID T. ARMSTRONG

Want to win some easy money? Just bet somebody you can advance a lathe tool into the work 0.010 in. and yet remove only 0.005 in. of stock from the surface. There's no "catch" to it; the tool is touching the work at the start. A moment's thought and it will be apparent that this is possible by feeding the compound rest in at a 30° angle.

Elementary trigonometry can not only be an aid to accuracy in any



The three lathe feeds can be compared to a right-triangle where the compound represents the hypotenuse

kind of lathe work, but also an aid to easier and faster work in many instances. This is true whether your lathe is a brand new toolroom model or an old and shaky veteran. For example, when the compound rest is set at an angle of 30° with the axis of the cross-slide, each 0.001-in. graduation on the compound rest dial will feed the tool 0.00087 in. in the transverse direction, removing 0.00173 in. on the diameter in a turning operation, and also will feed the tool 0.0005 in. longitudinally. Thus, possible errors are cut by a third transversely, and in half, longitudinally.

Sketching a triangle to correspond with the three lathe feeds will demonstrate these relationships. Because the longitudinal and crossfeeds are of necessity at right-angles, the triangle drawn will always be a right-triangle and the sum of the two acute angles will be 90°. The hypotenuse of a right-triangle is always the longest leg, so in the lathe application, the compound rest will always move further along its slide than the longitudinal and transverse motion it also produces. This fact can be taken advantage of to both improve accuracy as suggested above and eliminate tedious dial-squinting (and miking if you don't trust the dials any too well.)

To cite an example: suppose some parts have to be faced 0.017 in. shorter. A glance at any handbook will show that 0.17021 is the sine of 9° 48′ which means setting the compound to 9° 48′ will give a longitudinal feed of 0.017 in. for every 0.100 in. of compound feed—usually four complete revolutions of the knob. An even 10° angle would produce a feed of 0.01736 in.—less than half a tenth over—demonstrating that slight angular errors won't have much effect. Incidentally, the 10° angle gives a cross-feed of 0.0985 in. and an 80° angle will reverse the values.

Some will immediately say, "If you have several pieces to face off, why not use some kind of stops set to allow the 0.017 in. travel." To this I say, O.K. if you also have a way to chuck all pieces the same quickly. But it's my feeling that glancing in the handbook and setting the compound to transfer the feed into an even number of whole revolutions is a pretty quick way, and it eliminates any other settings or gadgets.

For straight turning and facing this method is good only for setting the tool in advance. Actual feeding is done with the longitudinal and crossfeeds.

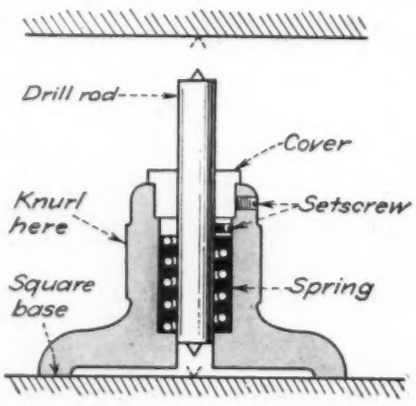
Transfer Punch Makes Alignment Marks

HOWARD C. DE HEER

This simple gadget was originally built for the purpose of transferring a center mark from the punch axis of a compound die set to the base so the circular pocket can be bored accurately.

Placed in the new die set, the device is moved by hand until the upper point on the drill rod pin indicates the center of the shank. Then the punch is brought down, compressing the spring until finally the pin touches the surface of the die. A light tap will mark both pieces in perfect vertical alignment so they can be separated and machined using the marks for centering in the lathe.

Construction is easy and the tool should prove valuable for all sorts of transfer jobs.



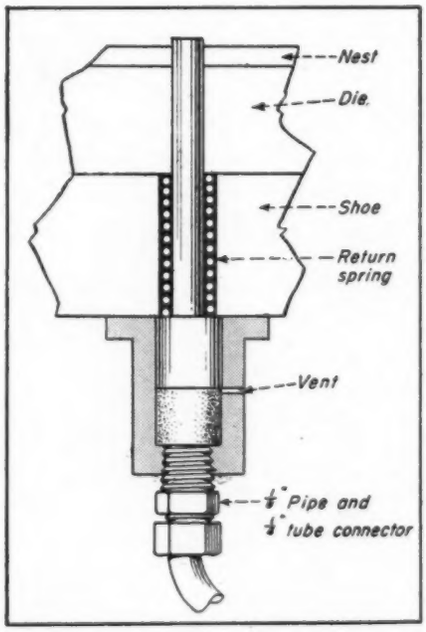
Lapped into its two bearings and then squared by grinding the base, this double-ended punch conveniently transfers any point location

Pneumatic Plunger Dislodges Small Press Parts

FRED JEDDELOH

In making dies, we were very often confronted with the problem of ejecting the finished part, when, for various reasons, a free blast of air, or the customary spring pressure pad was not suitable. Usually, the pieces were too tightly lodged for a free blast of air to bring them out and a spring ejector would always prevent the proper nesting when the parts were fed in and supposed to locate by gravity. (As in the case of most coining and forming dies, for example).

The answer to the problem was a



A small cam-controlled air cylinder frees work from the die enabling free air to convey it away

pin which would push up the part to be dislodged, and then a free blast of air to carry it away. However, the mechanical contrivance necessary to activate this pin would have to be rather complicated and would not be adaptable to all dies.

My final solution was a pneumatic cylinder to operate the pin which in turn was controlled by a timing cam on the press.

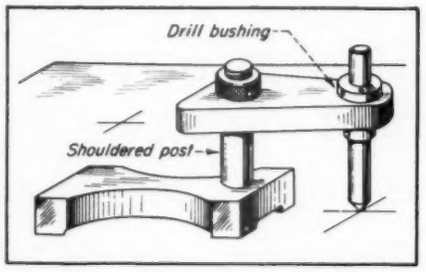
Bench Tool for Precision Center Punching

PETER L. BUDWITZ

During the course of their shop days a great many mechanics take considerable pride in developing their own special tools and devices in order to assist in performing various jobs quicker and better.

The accompanying illustration shows a bench tool developed for center punching intersecting layout lines more precisely on tool jobs of various natures. By guiding a precision-ground marking punch perpendicular to the work-surface a considerable contribution to accuracy in all drilling jobs is made.

A standard drill bushing is mounted in a bushing-plate arm, in turn fastened to a column and base with a knurled nut. The base is shaped for easy grasping with the fingers and the whole tool comes apart for compact storage.



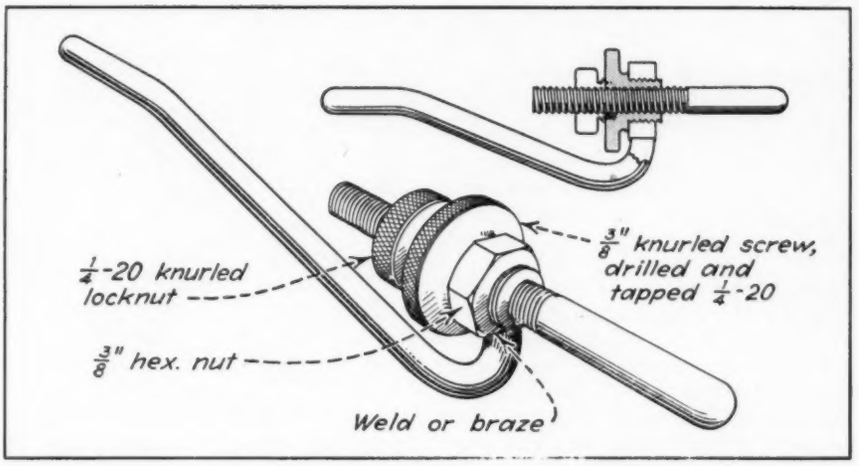
Simple construction employing a standard drill bushing makes layout punching easier, and faster

Inside Caliper Comes Apart Without Losing Setting

EMIL FRIEBEL

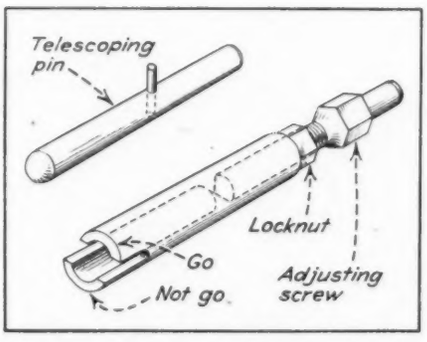
For gaging internal work when the opening is restricted, this tool comes apart for entrance and removal and can be quickly reassembled to restore the dimension.

The caliper frame consists of a hook to which is welded, brazed or screwed a ⅜-in. nut. The axis of the nut is lined up with the straight part of the frame. A ⅜-in. knurled screw is drilled concentrically and tapped ¼-20. The moving spindle is a ¼-20 screw and the assembly is provided with a clamp nut.



Quickly made from stock material, this caliper maintains its setting by locking two nuts together on the removable spindle

The unit can be inserted in work with all parts backed off sufficiently to clear the opening. First, the ⅜-in. nut is tightened by "feel," then the ¼-20 screw is brought up to gage the bore and the locknut set. Then, the ⅜-in. nut is unscrewed completely and the parts removed. Screwing them back together (without disturbing the ¼-20 screw at all) puts them back in the gaged position and the dimension can be taken off. As the distance from the fixed anvil to the face of the ⅜-in. nut is always the same, one step—reassembly—can be saved by just measuring from the end of the ¼-20 screw to the shoulder of the ⅜-in. screw and adding the fixed distance.



Ability to telescope plus provision for two gaging surfaces makes this a good instrument for checking the wear limits of internal ball races

Adjustable Internal Limit Gage Measures Ball Races

A. J. WORMWOOD

Here is a telescoping "go-not go" internal gage which will handle a fair range of diameters with the added ability of passing a narrowed opening in order to reach the belled interior.

The gage has three main parts: One of the pins screws into the body of the gage and has a locknut to set and hold any dimension. The other pin is a snug sliding fit in the opposite end of the body and has several special features. This end of the gage itself has a deep slot cut longitudinally down the centerline on both sides and one half of the end is ground off by the amount of the difference in limits. The pin itself has a small pin driven through it which projects at right angles on one side.

For inspection of several or many parts which are supposed to measure within the same limits, the gage is set with the small pin resting on one of the outer end surfaces. (Either may be used depending on whichever limit is to be set on the outside caliper.) Now, it can be collapsed without disturbing the locknut and fitted into the restricted opening. If it is impossible to expand the gage to the inner edge, the work is too small. If it will fit the inner edge but not the outer edge, the work is within the desired tolerances, and if it fits the outer surface, the work is too large.

A typical application for the tool is the often difficult job of measuring the inside diameters of ball races.

Notes on Metal Drawing

H. R. HAGEMAN

A previous PI "winner" for his suggestions on punching slots in thick stock, Mr. Hageman now discusses the principles of another phase of presswork.

There is no profit in reducing the number of operations in producing a drawn shell if the reduction results in too many fractured or stretched shells. The "kinks" here described have made possible the elimination of at least one operation in some cases, and made practicable the drawing of perfect shells in one operation which otherwise required two.

Referring to the drawing, Fig. 1, the 20° slant on the face of the draw die to which the draw-ring is closely fitted assists the flow of the metal and retains pressure on the blank until it is nearly all drawn into the die thus preventing wrinkling at the top of the shell which would cause fracture at the bottom. The flat at the top of the draw punch is no greater than that on the bottom of the final draw, the large radius remaining on the punch helps to give a considerable depth to the work before the actual drawing commences. Do not fail to provide air vents and use a strong enough screw to withstand the heavy pressure sometimes required to shed the shell off of the punch.

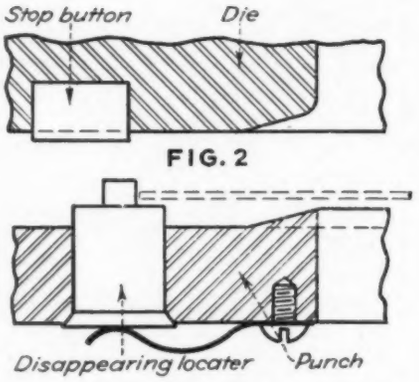


FIG. 2

Extra large circular blanks can be held tight enough to prevent wrinkling but not enough to allow stretching or tearing with stop buttons the thickness of the blank set in the die

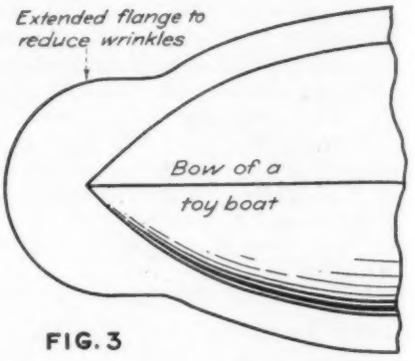


FIG. 3

Inexpensive, deep-draw pieces, made with simpler dies are improved by allowing more metal at abrupt corners thus preventing wrinkling, tearing or distortion around the flange

Fig. 2 shows the above described method applied to larger or irregular shaped parts which are blanked in a separate operation. The button extends above the face of either the die-steel or the blank-holder an amount equal to the maximum thickness of the blank which permits enough pressure to prevent wrinkling of the blank without pinching tight enough to cause tearing.

When it is desired to draw an irregular-shaped shell by stretching over the punch without fitting the die to iron out the shape, a certain amount of flange is necessary. If pronounced ridges or sharp corners are included, as in Fig. 3, it may be necessary to enlarge the blank at that point to obtain sufficient stretch and reduce the chance of splitting.

Probably the most rapid reduction in diameter of deep-drawn shells is accomplished by use of a die which turns the shell inside out but this method is practical only for very ductile, non-ferrous metal and maintenance of the tool is likely to be expensive.

In drawing, forming or bending sheet-metal parts involving considerable stretching or deformation of the metal, loss by spoiled work is sometimes caused by cracks starting at the edge of the blank and extending inward an amount in proportion to the strain on the metal. In such cases, it is well to investigate the edges of the blanks as it is surprising how little burr or edge-roughness may cause all the trouble. If a considerable number of blanks have been already made they can be salvaged almost 100% by smoothing in a tumbling barrel before further processing.

Common lard used as a lubricant made possible the deep drawing of a large number of blanks (which had been made of defective material) when many other lubricants had been tried and failed.

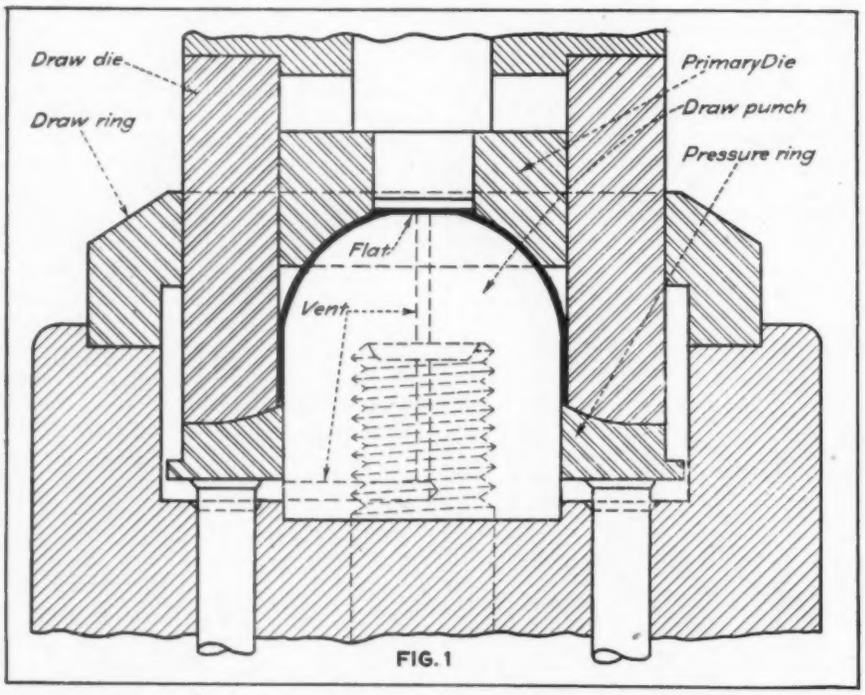


FIG. 1

Deep-drawing in a single operation is made possible with a double-acting or compound die and careful design of the angles at the mating surfaces and punch and die transition radii

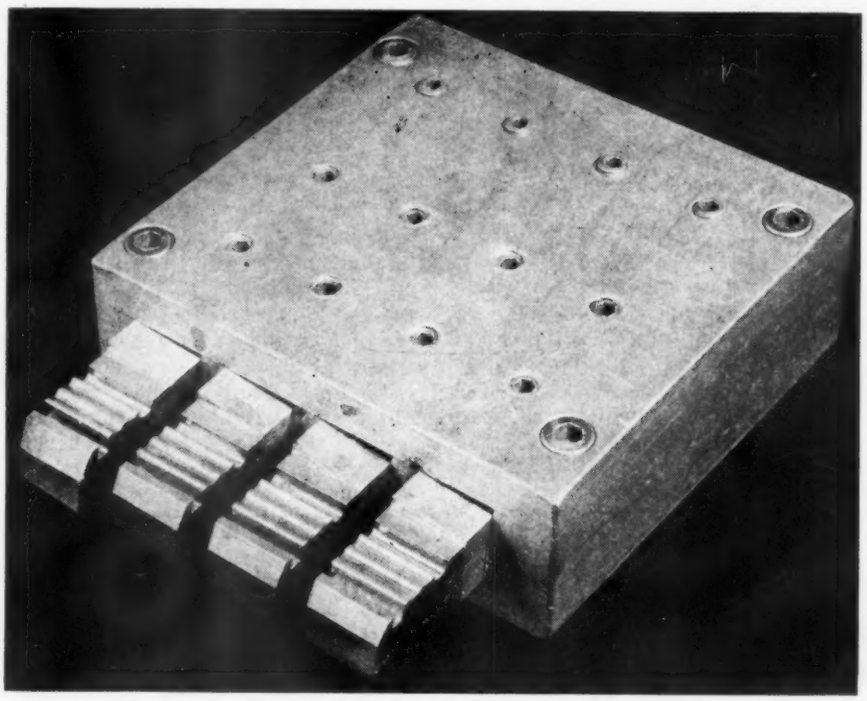
Graduations on the ½-in. end taper are in thousands of an inch diameter reduction

Special Holder For Grinding Form Tools

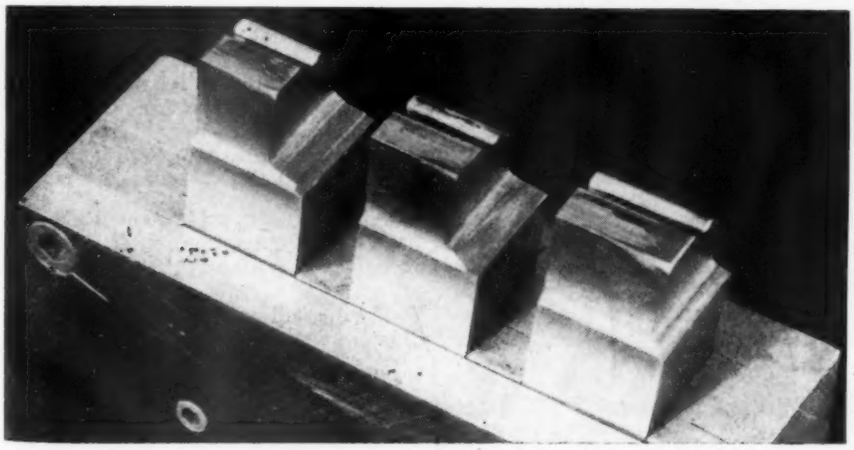
A. N. THOMASON
North American, Dallas

Three to four hours formerly were required for grinding each form tool. Tools were held in a vise, and when removed for comparator inspection, it was next to impossible to replace them in the same position in the vise.

The institution of holders of the type shown now permits grinding several toolbits at one pass and any one of them can be removed and replaced at any time for checking without disturbing the setup. Two holders are used; one positions toolbits for grinding the profile and the other holds them at right angles for the clearance and rake angles.



These toolholders permit easy duplication and regrinding of form tools. Above, holder for grinding the face; below, for grinding the rake



Taper Plug Gage For Jig Boring

LEE L. DODDS

In boring precision holes on the lathe or jig-borer, much time is lost in measuring the hole with telescoping gage and mikes. To overcome this loss of time, I have found it practical to alter a plug gage, as shown in the sketch above. Its use will indicate instantly how much metal is to be removed.

The only objection ever offered is, that if the hole is bell-mouthed, the gage will not give a true reading. So what? The answer to that is that the mechanic is using the wrong type of boring tool, or one which is not ground correctly. A properly shaped and ground tool will bore a straight hole.

When grinding the taper on the end of the gage, it is advisable to copper the surface and scribe a line exactly ½ in. from the end. This is important, as it will act as a guide in grinding and will save time in securing the correct diameter of the taper. It is also advisable to grind all sizes of your plug gages at the same setting, as it is a tedious job to set the tailstock over to the exact point to get the taper correct. By using a taper of 0.020 in. per in. the graduations from zero to ten thousandths are spaced 0.050 in. apart. If you desire wider spacings, you may make the taper 1 in. long, which will make for easier reading and will also permit you to guess at ½ or even ¼ thousandths in the accuracy of the hole. A keen eye can estimate to within 0.0001 in. diameter with this gage.

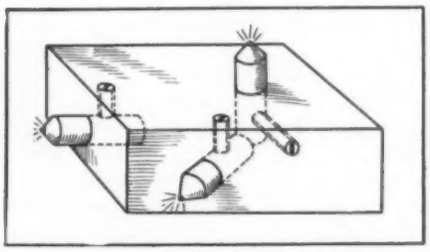
After grinding the taper, copper it again and lay out the spacings. This can be easily done on a small lathe by using the graduations on the longitudinal feed handle, with the scriber locked in the tool post. The graduations may then be made permanent with an electric pencil or by etching. Incidentally, if your etching acid seems a bit slow in "biting" into the metal, you can speed up the process by sprinkling a little table salt on it. In using the plug gage, care must

be taken to avoid wedging, of course, and the "feel" is delicate. The shallow groove permits normal use of the gage, the taper acting as a pilot.

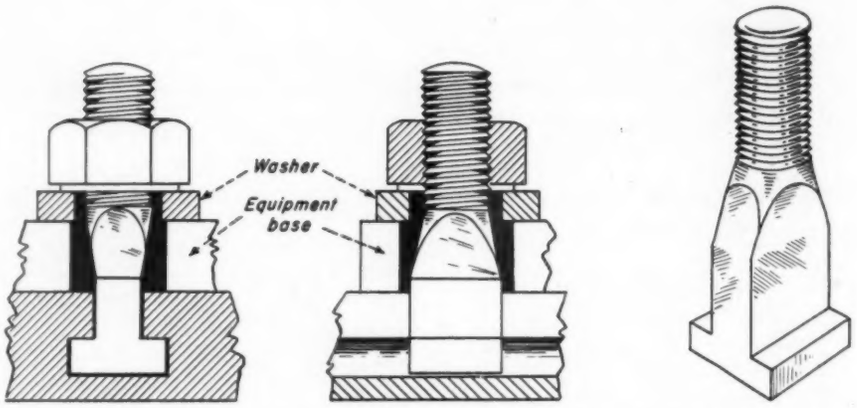
Three-Socket Diamond Holder Saves Time

WALTER DIMITRUK

Providing a 1-in.x3-in.x3-in. metal block with three holes and setscrews makes the dressing of all sizes and shapes of grinding wheels much faster. The diamond can be mounted in whichever hole seems best for the setup, eliminating a lot of traversing to bring a single-mount diamond into position against the wheel. If the class of work is of wide scope, another block with several different holes will diminish the dressing time still further.



Three hole-choices are possible in this dressing-diamond holder thereby reducing special table adjustments



Increased strength is possible in special cases by elongating T-bolt heads and fairing the neck into a screw larger than the slot itself

Oversize T-Bolt For Extra Heavy Work Holding

MICHAEL GOLDBERG
Ordnance Engineer,
BuOrd. Navy Department

The need for a stronger bolt than the one originally designed for holding a bedplate prompted an unusual design. The T-bolts normally supplied with the bed were of conventional design and did not have enough strength to hold the equipment down because of the severe lifting forces which the problem imposed. Therefore, it was necessary to design a stronger bolt to fit into the same T-slot. A rectangular head replaced the square head of the standard bolt, and a rectangular shank of uniform cross-section passed through the narrow part of the slot where it then began to expand laterally and contract longitudinally, gradually fairing into a circular cross-section of the same area as the long narrow rectangle. This provided a much larger bolt than the width of the slot, but the added permissible load on the bolt was well distributed over an equivalently greater area in order not to overload the machine T-slot.

NOW . . . $25 for the best Practical Idea in each issue

Jury of readers, different each time, to select top suggestion. Anyone with an idea can enter

Until further notice, an extra payment of $25 will be made for the best Practical Idea in each number of *American Machinist*. To avoid bias, the selection will be made by readers, a different group each time.

Payment—$25 in addition to regular rates for the item as published, to be paid as soon as reader votes are received—usually three to four weeks after the date of the issue. The winner will also be announced in these pages as soon thereafter as practicable.

Judges—A group of 200 *American Machinist* readers is asked to select preferred articles in each issue. The group is a true cross-section of all readers, and changes entirely each time. Their votes, in addition to guiding the editors, will hereafter select the best Practical Idea. If at any time their votes result in a tie, duplicate payments will be made. Judges' decisions are final in each case.

Requirements—Only items in the Practical Ideas pages are eligible, and they must be submitted directly by the originator. Do not worry about your shortcomings as a draftsman, photographer or author—every item will be edited in accordance with *American Machinist* standards and suitable illustrative or explanatory material added where needed. Readers will judge only the finished product—in terms of its usefulness to them.

Who May Enter—Anyone may enter except employees of the McGraw-Hill Publishing Co., Inc., and those of advertising agencies or departments.

How to Enter—Send your entry to "Practical Ideas Editor," American Machinist, 330 West 42nd St., New York 18, N. Y.

Third Selection: Michael Axler on V-Block Lathe Centering

Watch and Instrument Threads—I

SCREW THREADS FOR HOROLOGICAL (WATCH) INDUSTRY*

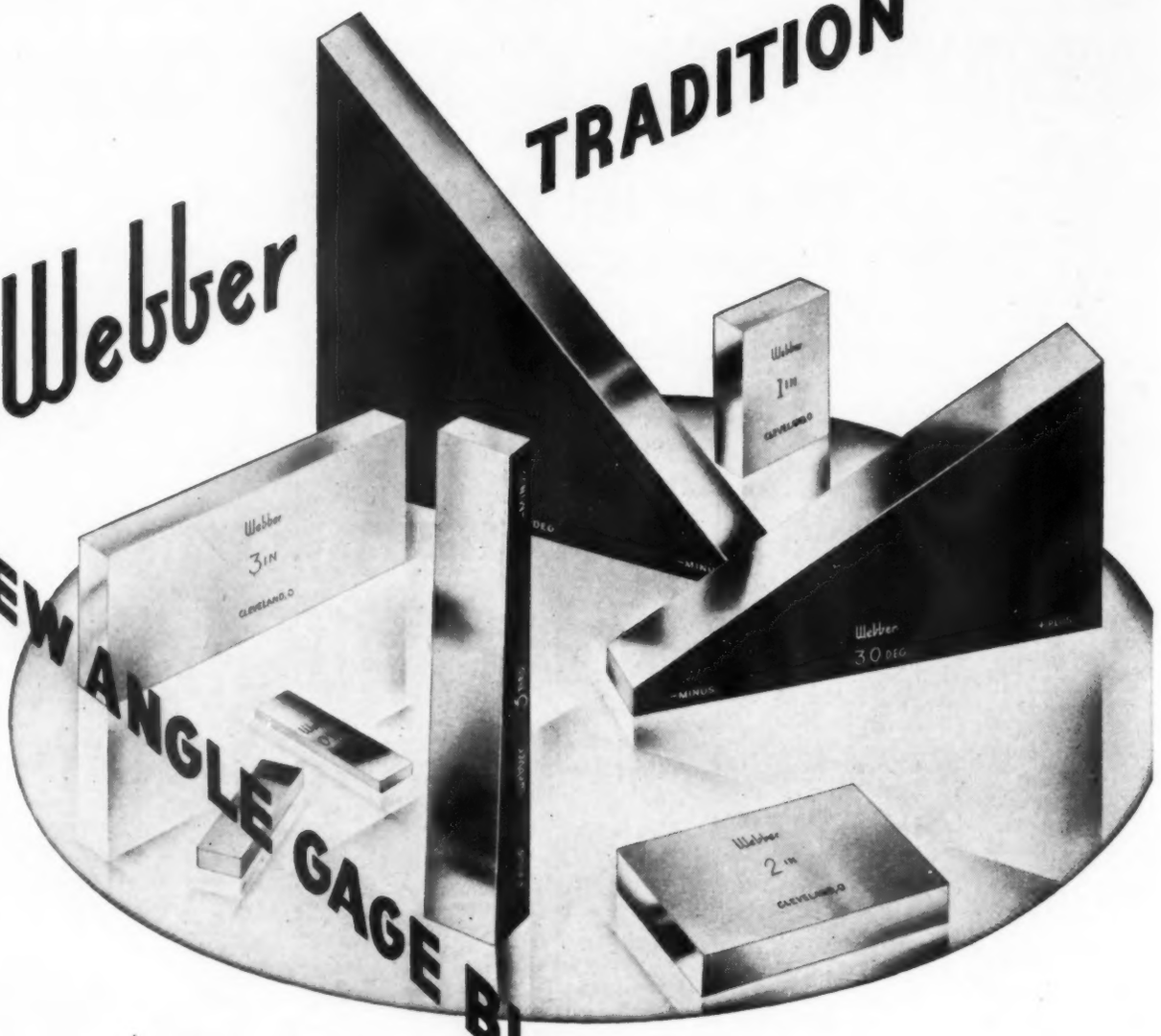
50° Thread Angle

60° Thread Angle

Nominal Size or Designation 50° thread angle	Screw		Nut		Pitch Dia.	Pitch T.P.I.	Depth of Threads	Depth of Engagement	Clearance	Root Radius
	Major Dia. d	Minor Dia. dk	Major Dia. D	Minor Dia. Dk	df	l/h	ts	tg	a	r
30 NHS	0.0118	0.0077	0.0121	0.0080	0.00990	338 2/3	0.00205	0.00190	0.00015	0.00035
35 NHS	0.0138	0.0097	0.0141	0.0100	0.01185	338 2/3	0.00205	0.00190	0.00015	0.00035
40 NHS	0.0157	0.0102	0.0161	0.0106	0.01320	254	0.00275	0.00255	0.00020	0.00046
45 NHS	0.0177	0.0122	0.0181	0.0126	0.01515	254	0.00275	0.00255	0.00020	0.00046
50 NHS	0.0197	0.0128	0.0202	0.0133	0.01650	203 1/5	0.00345	0.00320	0.00025	0.00058
55 NHS	0.0217	0.0148	0.0222	0.0153	0.01845	203 1/5	0.00345	0.00320	0.00025	0.00058
60 NHS	0.0236	0.0153	0.0242	0.0159	0.01980	169 1/3	0.00415	0.00385	0.00030	0.00070
70 NHS	0.0276	0.0180	0.0283	0.0187	0.02310	145 1/7	0.00480	0.00445	0.00035	0.00081
80 NHS	0.0315	0.0205	0.0323	0.0213	0.02640	127	0.00550	0.00510	0.00040	0.00093
90 NHS	0.0354	0.0230	0.0363	0.0239	0.02970	112 8/9	0.00620	0.00575	0.00045	0.00104
60° deg. thread angle										
100 NHS	0.0394	0.0256	0.0404	0.0266	0.03300	101 3/5	0.00690	0.00640	0.00050	0.00057
110 NHS	0.0433	0.0295	0.0443	0.0305	0.03690	101 3/5	0.00690	0.00640	0.00050	0.00057
120 NHS	0.0472	0.0334	0.0482	0.0344	0.04085	101 3/5	0.00690	0.00640	0.00050	0.00057
130 NHS	0.0512	0.0347	0.0524	0.0359	0.04350	84 2/3	0.00825	0.00765	0.00060	0.00068
140 NHS	0.0551	0.0386	0.0563	0.0398	0.04745	84 2/3	0.00825	0.00765	0.00060	0.00068
150 NHS	0.0591	0.0426	0.0603	0.0438	0.05140	84 2/3	0.00825	0.00765	0.00060	0.00068
160 NHS	0.0630	0.0437	0.0644	0.0451	0.05405	72 4/7	0.00965	0.00895	0.00070	0.00080
170 NHS	0.0669	0.0476	0.0683	0.0490	0.05800	72 4/7	0.00965	0.00895	0.00070	0.00080
180 NHS	0.0709	0.0516	0.0723	0.0530	0.06190	72 4/7	0.00965	0.00895	0.00070	0.00080
200 NHS	0.0787	0.0567	0.0803	0.0583	0.06850	63 1/2	0.01100	0.01020	0.00080	0.00091

*This screw thread series, based on the Swiss NHS thread series but transposed into inch units, has been adopted by Hamilton Watch Co. for all new watch designs. It is now being considered by the American Standards Association as a standard for the watch industry.

IN Webber TRADITION



NEW ANGLE GAGE BLOCKS

The New WEBBER ANGLE GAGE BLOCKS, in the tradition of WEBBER precision craftsmanship, make angle measurement a simple, fast and sure operation. Accurate to within one five-millionth part of a circle. Furnished individually or in 3 sets:

Set No. 14-A: 0 to 103 degrees in 1 second steps — total of 370,800 angles $450.00

Set No. 10-A: 0 to 103 degrees in 1 minute steps — total of 6,180 angles $350.00

Set No. 6-A: 0 to 103 degrees in 1 degree steps — total of 103 angles $235.00

Webber GAGE COMPANY

12901 Triskett Road • Cleveland 11, Ohio

Watch and Instrument Threads—II

DIAMETER TOLERANCES FOR WATCH SCREW THREAD SERIES*

Nominal Size or Designation	Major Diameter Screw		Pitch Diameter Screw		Minor Diameter Nut		3-Wire Measurement		
	Max.	Min.	Max.	Min.	Min.	Max.	Wire Size	Max.	Min.
30 NHS	0.0118	0.0112	0.00990	0.00945	0.0080	0.0088	0.00180	0.01278	0.01233
35 NHS	0.0138	0.0132	0.01185	0.01140	0.0100	0.0108	0.00180	0.01478	0.01433
40 NHS	0.0157	0.0149	0.01320	0.01260	0.0106	0.0116	0.00240	0.01700	0.01640
45 NHS	0.0177	0.0169	0.01515	0.01455	0.0126	0.0136	0.00240	0.01900	0.01840
50 NHS	0.0197	0.0188	0.01650	0.01580	0.0133	0.0145	0.00300	0.02133	0.02063
55 NHS	0.0217	0.0208	0.01845	0.01775	0.0153	0.0165	0.00300	0.02333	0.02263
60 NHS	0.0236	0.0225	0.01980	0.01895	0.0159	0.0173	0.00360	0.02555	0.02470
70 NHS	0.0276	0.0263	0.02310	0.02215	0.0187	0.0203	0.00420	0.02988	0.02893
80 NHS	0.0315	0.0301	0.02640	0.02535	0.0213	0.0231	0.00480	0.03410	0.03305
90 NHS	0.0354	0.0338	0.02970	0.02850	0.0239	0.0259	0.00540	0.03833	0.03713

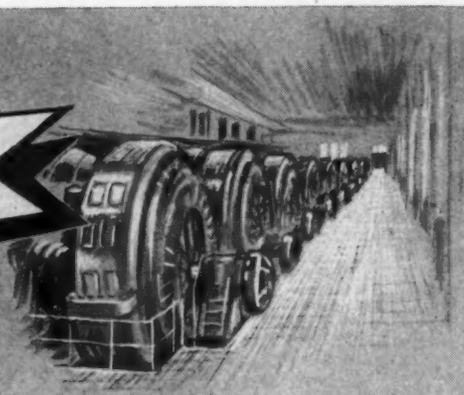
*These tolerances, established by Hamilton Watch Co., include sizes 30 NHS to 90NHS (50-deg. Series). The wire sizes and maximum and minimum measurements given in the table hold the required tolerance on the pitch diameter.

TAP DRILLS FOR SMALL SIZES OF AMERICAN NATIONAL FINE THREAD—CLASS 3 FIT**

Size of Screw and Thrds	LIMITS				TAP DRILL SIZES			
	Dia. Body or Major Dia. Screw	Basic Pitch Dia.	Tapped Hole	Screw	Internal Thread Minor Diameter	75% to 80% Full Thr'd Wrought Brass Nickel Babbitt Wr. Alum. Alloy Fiber White Metal Hd. Rubber	70% to 75% Full Thr'd Mild Steel Cast Alum. Cast Irn Cast Brass	65% to 75% Full Thr'd Bronze Tool Steel Drop Forging Stainless St'l Cast Steel Nickel Copper	Clearance Drill
00-96	0.047 +0.0000 −0.0032	0.0402	+0.0010 −0.0000	+0.0000 −0.0010	0.0357 +0.0024 −0.0000	64 (0.036)	63 (0.037)	63 (0.037)	55 (0.052)
0-80	0.060 +0.0000 −0.0034	0.0519	+0.0013 −0.0000	+0.0000 −0.0013	0.0465 +0.0027 −0.0000	55 (1.052) 56 (0.0465)	55 (0.052)	55 (0.052)	51 (0.067)
1-72	0.073 +0.0000 −0.0036	0.0640	+0.0013 −0.0000	+0.0000 −0.0013	0.058 +0.0030 −0.0000	53 (0.0595)	53 (0.0595)	52 (0.0635)	47 (0.0785)
2-64	0.086 +0.0000 −0.0038	0.0759	+0.0014 −0.0000	+0.0000 −0.0014	0.0691 +0.0033 −0.0000	50 (0.070)	49 (0.073)	48 (0.076)	42 (0.0935)
3-56	0.099 +0.0000 −0.0040	0.0874	+0.0015 −0.0000	+0.0000 −0.0015	0.0797 +0.0037 −0.0000	46 (0.081)	45 (0.082)	44 (0.086)	36 (0.065)
4-48	0.112 +0.0000 −0.0044	0.0985	+0.0016 −0.0000	+0.0000 −0.0016	0.0894 +0.0043 −0.0000	43 (0.089)	42 (0.0935)	41 (0.096)	31 (0.120)
5-44	0.125 +0.0000 −0.0046	0.1102	+0.0016 −0.0000	+0.0000 −0.0016	0.1004 +0.0045 −0.0000	38 (0.1015)	37 (0.104)	35 (0.110)	29 (0.136)
6-40	0.138 +0.0000 −0.0048	0.1218	+0.0017 −0.0000	+0.0000 −0.0017	0.1109 +0.0049 −0.0000	33 (0.113)	32 (0.116)	31 (0.120)	26 (0.147)
8-36	0.164 +0.0000 −0.0050	0.1460	+0.0018 −0.0000	+0.0000 −0.0018	0.1339 +0.0052 −0.0000	29 (0.136)	29 (0.136)	28 (0.1405)	17 (0.173)
10-32	0.190 +0.0000 −0.0054	0.1697	+0.0019 −0.0000	+0.0000 −0.0019	0.1562 +0.0056 −0.0000	21 (0.159)	20 (0.161)	19 (0.166)	7 (0.201)

**These tap drill sizes for different materials have been adopted by Kollsman Instrument Division, Square D Co., to provide the accuracy required in aviation instruments. The tolerances on pitch diameter apply only to Class 3 fit and up to ½ in. length of thread engagement.

THE ELECTRICAL INDUSTRY



Whether it is drilling motor end bells, device parts or plastics, AMPCO cutting tools have been consistently used with gratifying results.

This wide acceptance of AMPCO tools in the electrical industry is the result of long, cost saving experience with these high quality tools.

AMPCO TOOLS

• DRILLS • REAMERS • END MILLS

AMPCO TWIST DRILL COMPANY

FACTORY AND MAIN OFFICE
Jackson, Michigan

CHICAGO ☆ DETROIT ☆ PHILADELPHIA

NEWS OF METALWORKING

Chicago Plants Crippled by Power Dimout

Production loss ran around $10,000,000 weekly, and thousands lost jobs. Effects of coal strike will be prolonged

CHICAGO—An electrical power cut that made wartime dimouts seem only rehearsals had practically closed down Chicago area industries before the two-week truce in the coal strike. This region received the first and most drastic effects of the coal strike because Commonwealth Edison Company, which at the start of the war carried a 122 day coal supply, was forced by government regulations to maintain only a 50 day supply when the strike started April 1.

Estimates of the full magnitude of the power blackout varied, but the Chicago Association of Commerce said the minimum production loss in the city was $10,000,000 a week.

Severe Ramifications

Officials of metal working industries were unanimous in declaring that effects of the shutdown and the coal strike would be felt long after output returns to normal. The already confused situation in the Chicago area caused by the earlier steel and farm implement strikes has been still further muddled by the sweeping cutback of production attributable to the coal strike.

One effect of the uncertainty caused by the strike is the curtailing of previously scheduled expansion plans. It is reported that a number of companies that intended to introduce new products have postponed them indefinitely, and in several cases it was said that the new items would definitely not appear this year even if all production difficulties ended at once. These casualties cover a wide range and include a number of home appliances.

Working Schedules Cut

Some of the results of the coal strike and consequent power slash on individual companies were these:

U. S. Steel's Gary sheet and tin mill's sheet division shut down, as did the Cyclone Fence Company's De Kalb division. Three East Chicago foundries laid off 3,000 men, and two lead foundries in the same area laid off 500. Youngstown Sheet and Tube closed East Chicago mills, dismissing 800 workers. In Lake County, Ind., alone it was estimated that 100,000 workers were affected.

Pullman Standard's Chicago plant had its own power facilities, but operations had been on a reduced level because coal was short. The two Hammond plants of Pullman were on a three day week, and the Hammond foundry was cut to one day a week. Pullman officials disclosed that work scheduled to start this month on rail equipment cannot now start before September at the earliest.

The Joliet and Waukegan plants of American Steel & Wire were shut down. Harvester had its plants, employing 24,000 workers, on a one-day week. Maremont Automotive Products Co., with 1,200 workers in Harvey, Cicero and Chicago, closed down, as did the Columbia Tool Steel Co. in Chicago Heights.

Other Industries Down

Stewart-Warner Corp. worked on three eight-hour days a week, and night workers were shifted to the day schedule according to seniority ratings. Those above the number needed for one shift were laid off. Western Electric, which had been on three-shift daily operation, cut down to 24 hours a week in its plant making telephones. But in the main Hawthorne Works the company continued on full schedules.

Radio parts makers in the Chicago area were all on the 24 hour a week schedule, with the result that set makers throughout the nation prepared to cut production two-thirds.

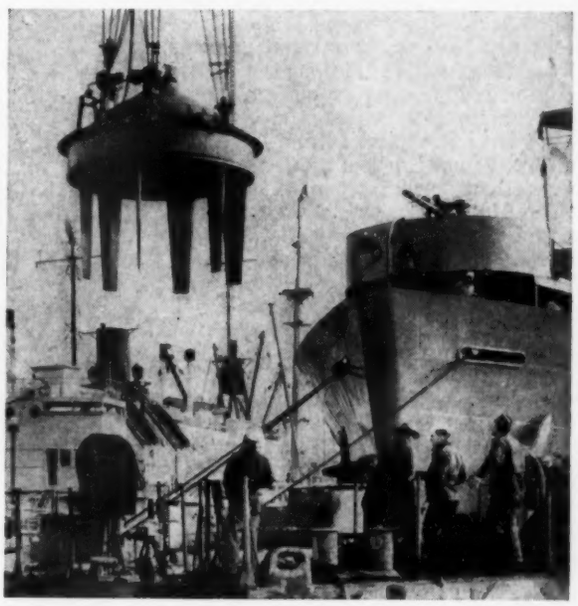
The Hummer Mfg. Co. and the Baker Mfg. Co. in Springfield closed down, and Caterpillar Tractor in Peoria laid off half its 18,000 workers.

LEAD SHORTAGE CUTTING STORAGE BATTERY OUTPUT

ST. LOUIS, MO.—Apprehension over the increasing shortage of lead is evidenced by spokesmen for the non-ferrous mining industry. Production of refined lead has dropped steadily for the past three years and 1946 output will be considerably below that of 1945. Strikes in the Western mines; difficulties under the OPA premium pricing plan; and a lack of mine development and exploratory work dating back to the depression account for the lead shortage.

With the automobile industry hoping to get into high volume production later this year, and with storage batteries constituting a principal tonnage use of lead, some quarters fear that batteries may eventually become a serious bottleneck for the auto makers.

Even under the most favorable conditions the demand for lead is expected to exceed the supply for a period of years.



New Blade Propeller—A new cycloidal propeller is being lowered into position on a Navy LSM. Tests show these propellers produce greater maneuverability than the old type. Each propeller has an orbit diameter of 7 ft., and is equipped with 6 vertical blades, each revolving on its own axis

Gaging Business

Record Steel Output

If the current coal truce winds up in a settlement of the strike, the steel industry could still produce some 70,000,000 tons of steel, which would set a new peacetime peak. Barring further labor trouble, this would be quite an accomplishment, especially in view of the fact that 1946 steel output thus far is some 12,000,000 tons behind production for the first four-and-a-half months of 1945.

Despite this, the recent coal strike cost the steel industry 2,000,000 tons of production, past and pending, due to interrupted operations. This should be added to the 8,000,000 tons lost during the steel strike of a few months ago, plus certain other production losses due to various other factors.

The lost steel production has hopelessly upset the production schedules of many metalworking industries and thrown their order books out of kilter. Lack of coal, deferred delivery of steel, castings and other parts or materials leaves most industries unable to lay down a firm production schedule until the nation's productive machinery is in gear again.

Westinghouse Output Resumed

Adding to the temporarily brightened labor situation was the end of the 119-day Westinghouse strike which had tied up production of electric motors and controls and parts for a host of industries. Once Westinghouse's output arrives at customers' plants, supplementing the output of General Electric, shipments of various finished products, all the way from machine tools to household items, will zoom upward. Many manufactured items, all finished except for one or two missing parts, have been waiting idly at company plants and storage spaces until bottleneck items are available again.

Increased output of motors will enable the machine tool industry to firm up delivery promises in the near future. Until now, lack of motors hampered the setting of definite delivery dates.

Machine Tool Business

Despite strikes, poor deliveries, and increased prices, machine tool business continues steady, with some increases reported in various areas. The major reason given by industry experts for the volume of business is that industry realizes that more and better machinery is the only solution to reduced manufacturing costs in the face of higher labor and material prices. Because of this, expansion and modernization plans in most industries are being pushed, regardless of currently discouraging factors.

A spot survey of various equipment builders indicates that the industry has taken an average price increase of 15%, even though the OPA recently granted the industry the right to lift prices 20%. Some builders have required this margin to offset unusual advances in labor and material costs, and on some of their lines, production of which had been suspended. On the other hand, many builders have kept their price boosts as narrow as possible, perhaps to the surprise of the OPA. However, the indications that coal prices will rise, and that steel prices may rise further might necessitate further price boosts later on.

Labor Legislation Likely

The damaging effects of the coal strike upon the entire economy have driven home to Congress the need for more equitable labor laws, to place unions in a similar position of responsibility as the other segments of the economy. Unless such legislation is forthcoming in the near future, new damaging strikes will develop. One such strike is the threatened maritime tie-up, which would prevent exports of badly needed American goods to various destitute areas of the world, and interrupt imports here of badly needed supplies of foreign nonferrous metals and ores. If the rail strike should become an actuality, its paralyzing effect is obvious.

Aside from these specific strikes, there are many small tie-ups which have not won national notoriety, but have hampered output of many bottleneck items, right along the line. Moreover, the nation has been promised a series of jurisdictional strikes as the CIO and AFL get organizing drives under way.

The major uncertainty of future labor conditions leaves many observers doubtful that this year will see many peacetime records in production set.

U.S. Strikes Cost Canada 500,000 Tons of Steel; Relief for Equipment Prices

OTTAWA — Steel users in Canada must prepare to get along with at least 500,000 tons less steel in 1946 regardless of temporary settlement in the U. S. coal strike.

Unless a work stoppage closes Canadian steel mills entirely, the Government is unlikely to clamp a rationing system on steel consumers. Instead, it will probably only continue its present actions of (1) subsidizing certain tonnage movements to maintain full capacity output at Canadian steel plants, (2) approving priorities for orders of steel to be used for housing and the manufacture of farm equipment, and (3) exercising a "screening" control over all orders for export.

With many American buyers turning to Canada in desperation, and with overseas orders still pouring in, the effect of this last control has generally been that most new business has been turned down entirely, particularly "unusual" orders.

Capital Goods Ceilings

Now that basic steel prices have been increased, the next step in Canada's "orderly retreat" from price control will lift ceilings completely from capital equipment. As in the United States, the decision to let capital goods set their own price levels reflects the consideration that in dollar value they represent only a small proportion of the total retail sales figure, but the large saving in time by not having to adjudicate hundreds of prices was also a factor.

Extend Double-Depreciation

Where, six months ago, the administration was seeking ways of encouraging plant improvements to stimulate employment, now, to avoid an excessive burden of industrial construction, it has taken steps to delay them. By adding 15 months to the period during which advantage may be taken of the "double depreciation" privilege (AM—January 31, page 214), some of the pressure will be taken off the construction industry, already faced with more than it can handle in meeting the critical need for housing. Now Canadian firms have until March 31, 1948, to undertake such expansions. Applications must be filed before March 31, 1947.

Up to April 13, a total of 2,107 certificates for capital outlays totaling $284,389,652 had been granted.

Aluminum Price Cut

Presaging an even more aggressive bid for world markets by Aluminium Ltd., its foreign sales subsidiary, Aluminum Company of Canada, Ltd., has reduced its price on virgin aluminum ingot to 13¼ cents per pound, as had been widely speculated about after the company's 12 cents per pound price for the 430 million pound export agreement with the United Kingdom. Converted to U. S. currency the ingot price is equivalent to 12.04 cents per pound.

Restricted Rail Shipments Hasten Cut In Steel Output; Orders Pushed Back

PITTSBURGH—The two-week coal truce was of dubious value to the steel industry, which could little afford to start up furnaces for a short resumption of operation with the threat of a renewed shutdown. Meanwhile, operations slumped lower in the face of the coal shortage and the rail embargo, the latter of which was also lifted for a brief period. There were few indications that developments could avoid the loss of steel production in the current coal strike exceeding 2,000,000 tons.

Because of the method of distribution of coal stocks when the miners' strike started in April, the sag in the steel industry has been more or less gradual and irregular within the confines of specific districts. Thus, while the ingot rate for the Pittsburgh district has gone down from 101 to 47% within six weeks, Carnegie-Illinois' Monangahela Valley plants are operating at 11% while Jones & Laughlin is at 95%.

Steel Can't Be Stocked

The temporary freight embargo, which might be reinstituted at any time, served to further depress steel industry operations. The reason is steel plants cannot stock their output except in small amounts, and inability of the railroads to move freight will nullify the efforts of steel managements to maintain their furnaces in operation and their employees at work. Fabricators already have been affected and will go down further, first as a result of the steel shortage, and second, as a result of freight developments.

If and when the steel strike is definitely over, it will take the industry two full weeks for complete recovery. Even then, coal mining must allow for winter reserve stocks.

Because of priorities granted in manufacture and shipment of certain steel products since April 1, some steel consumers have been hard hit for weeks and this will be extended. The construction crisis will have been extended and reconversion thereby delayed.

Shipments Disrupted

While tinplate has been given a clear track, some loss of production is inevitable, and some food packs will suffer. Sheet and strip rolling was maintained as long as possible because of the profitable nature of the product, but automobile companies were finally affected and will be delayed in resumption. Aside from this, allocations and shipments have been hopelessly disrupted by the coal strike, which has added confusion to the upsetment resulting from the January-February steel strike.

Unfilled orders have been moved backwards and tonnages expected to be shipped in 1946 will have to go over into 1947. Consumers are now attempting to get firm places on company books for 1947 to permit firmer scheduling of next year's operations.

Prices are still important to the industry, despite recent opposition to obtain relief based on March costs. But with higher coal prices in the offing, the Industry is expected to make new representations to OPA.

Western Electric May Lease RFC's Curtiss Kenmore Plant

BUFFALO—The Western Electric Co., Inc., is reportedly negotiating with the Curtiss Wright Corp. for the lease of the big Curtiss Kenmore, N. Y. plant and it is understood the plant will be used for light manufacturing purposes.

Western Electric is understood to be seeking a five-year lease on the 765,000 sq. ft. Curtiss plant with an option to buy. Western Electric is reported to be interested in the Government-owned section of the plant, built during the war, but it was not learned whether any specific offer has been made to the RFC, for the plant, which has been out of production since V-J day.

Higher Coal Price, Higher Freight Rates, Aftermath of Wage Pressures

WASHINGTON — Coal prices and freight rates are effected to rise under the pressure of wage increases to both coal miners and railroad workers.

Sixty-one percent of the price of a ton of coal goes for labor. Almost any increase in coal wages is reflected in coal costs. The railroads then have to add increased coal costs to the wage increases granted their employees. This means higher freight rates and higher shipping costs to manufacturers, who also have to pay more for their coal and higher wages to their own workers.

Disruption of production and shipping caused by the coal strike hasn't helped matters either.

$150,000,000 Loss

The coal strike cost the country two million tons of soft coal a day. The average price of soft coal for the last nine months of 1945 was $3.11, making the loss $6,220,000 a day. The average production cost per ton was $2.97, of which $1.78 went for labor, which means that on the basis of two million tons a day the miners lost $3,560,000 a day in wages. These are based on statistics of the Solid Fuel Administration. This brings the economic loss due to the strike at around $150,000,000.

Effects of the coal strike will be felt for a long time to come. Even with the ending of the strike industry faces a serious maladjustment in the distribution of coal. Rationing has been threatened. All the coal that can be produced will be needed in months ahead. There is less chance now that the mines will go ahead on the normal 35-hour week. They have been working six nine-hour days.

One result of the situation may be increased mechanization of the mines, which was stopped by the war. The industry has been only 56% mechanized, chiefly because some mechanical equipment was impractical under certain mining conditions. But improved designing of machinery is expected to make mechanical equipment useful under conditions which previously precluded its use.

Higher Freight Rates

The railroads are likely to get higher freight rates from the Interstate Commerce Commission, but it probably will not happen until about the time price controls are lifted, or about to be lifted. Government stabilization officials contend that industry will then be in a better position to absorb increased freight rates without raising prices. If price controls are gone, they may reflect the rate increase in their prices if their competitive position will permit it.

The railroads have asked for a rate increase of 25%. They base their claim on the higher wage costs and an estimated net loss of $345,000,000 in 1946 under present wage and price levels and prewar freight rates.

An arbitration board awarded a 16c hourly increase to members of 15 non-operating and three operating unions. These unions immediately filed a demand for an additional 14c increase, representing the difference between the 16c awarded and their 30c demand. The two remaining operating unions, the trainsmen and the locomotive engineers, submitted their demands to a fact-finding board which also recommended 16c. They rejected the recommendation and threatened to strike.

Parts, Material Bottlenecks Factor Delaying Machine Tool Price Boosts

CLEVELAND—One of the major reasons why machine tool builders are going slow on announcing a revision in the price structure of their products is the chaotic parts situation. Motors are still a bottleneck, but other scarce articles include castings and bearings, the latter of which shortages has eased somewhat.

Tools are still standing in many plants in the industry in various stages of completion, held up by missing parts. Completion under adverse conditions often involves higher prices for materials and parts. As an example, one Cleveland tool buider who suddenly found his regular source of supply for castings dried up due to labor difficulties, finally secured a substitute southern source but found transportation costs and other attendant expenses prohibitive. The result was that the tool builder had to curtail his operations until his normal castings source was available again.

Price Boosts Deferred

The industry is delaying raising prices the full 20% allowed under the latest OPA price ruling because it is waiting to determine final costs on materials and prices, once the present inflationary wave has settled, before setting new prices. Meanwhile, a few builders have taken the full 20%, others have limited increases from 5-15%, while the majority are delaying price action for the present.

Dealers, because of price uncertainty, are being held back to a certain extent in promotional activities since they sense the danger of relying too much on the price lists in their hands right now. Before an order for a machine tool is booked now, the dealer double checks on the price with his manufacturer.

The National Machine Tool Builders Association has protested the recent UNRRA order to the effect that no new machine tools are to be ordered from U. S. machine tool builders, since all future UNRRA purchases will be made from government surplus tools. The reason is that the industry wants to rebuild surplus tools before they are shipped abroad, in order to assure that they would reach their ultimate destination in good condition. If surplus tools are purchased for foreign use without reconditioning, the industry fears that it may harm the reputation of the U. S. industry abroad, as was done after the first World War.

Coast Outlook Optimistic Except For Shipbuilding; Kaiser Bids For Yard

SAN FRANCISCO — Metalworking companies here are driving through the conversion period and into peacetime production with a strong display of will and ingenuity. In general, the picture reveals that employment is somewhat below war production peaks but above the prewar level. In all but the shipyards, the future has an optimistic tinge, with many owners expecting to surpass even the figures recorded in 1944 and 1945. Problems facing manufacturers seem to be principally the lack of raw materials, shortages of component parts made in the east, and a lack of skilled workers.

Three Types of Plants

Conversion problems vary for the three main classifications of manufacturers in the area. For the first class, those whose prewar product was a useful wartime one, the transition from war to peace is relatively simple.

A second type of shop, whose products were drastically altered or completely changed to fit a requirement of military supply, is faced with returning to its primary field, or finding a market for a variation of its recent production facilities. An example of complete reversal in a firm's output is found in the Production Engineering Co. in Berkeley. During 1940 this shop was making jig borers and precision boring machines with about 150 employees. With the war, and 850 additional employees, their products spread to include bomb parts, fuses, rocket casings, thrust bearing, and other items. Today they are in production on large orders of home-craft power saws, and expect to develop a full line of small wood and metalworking machines.

The third type of shop is the "war baby." The Consolidated Engineering Co. of Oakland is such a shop.

With a fist full of subcontracts, the company went into business manufacturing doors, hatches, and gun foundations for cargo ships. Recently, Consolidated's energetic manager, C. R. Kelsey, scraped up some orders for farming and road equipment components, and his war baby will grow.

Practically a war baby is the Joshua Hendy plant at Sunnyvale. Although in business before the war with a small force manufacturing mining equipment, they hit a wartime high of 7,100 workers whose main output consisted of marine propulsion machinery. Today they are making a line of stationary turbine power plants ranging in capacity from 250 kw. to 10,000 kw., diesel engines, and have orders on their books for three huge custom built coating machines.

Companies expecting to make expansion strides over their wartime peaks are such firms as Rheem Manufacturing Co., the Hall-Scott Motor Car Co.

Caterpillar Tractor Co., San Leadro, which manufactures fuel injection equipment for the company's farm and construction machinery, will continue at a steady pace with usual 1,000 workers. The same is true of the California Corrugated Culvert Co., The Victory Equipment Co., The Merco Nordstrom Div. of Pittsburgh Equitable Meter, and others.

Shipyard Situation

The shipyards naturally have the toughest fight for survival in the conversion period, and most of the smaller ones will not make the grade. The shipbuilding division of Bethlehem Steel will pull through, as it always has. At present the company even has orders for ships whose keels have not yet been laid. Some yards, such as Western Pipe & Steel and Moore Dry Dock, are finishing up on present construction. Some yards are in existence now only because of repair and conversion work that may keep them going for some time. With San Francisco Bay spotted from end to end with groups of ships that will find their way before long to the junk heap, some of these yard may find life in these junking operations.

Big question mark in the shipyard situation here is what is going to happen to the four yards in Richmond operated by Henry Kaiser during the war. They are now up for sale or lease by their owner, the Maritime Commission. Kaiser is known to be interested in all four, with special designs on Yard 3, which was built with the idea of postwar operation. It differs from the others in that it is composed of a series of concrete drydocks. Kaiser plans may be upset by the recent bid of the city of Richmond who, it seems, would have priority over Kaiser as set forth in the Surplus Property Act. With the exception of yard three, it is known that Kaiser would use the property for other purposes than ship construction and repair. Manufacture of giant cargo planes, freight cars, household appliances, and automobiles have been mentioned as possibilities by Kaiser spokesmen.

Detroit Letter

Auto Output Crippled

The short embargo on freight shipment as the result of the coal strike and continuing restricted steel operations have practically shut down the automobile industry here. The plants that have not yet shut down assembly lines will do so momentarily.

The Ford Co. has already sent most of their 110,000 workers home because of failure to receive supplies of parts. Only a few of its operations are proceeding.

General Motors announced May 9 that in ten days it would cease operations. Some of its divisions may shut even sooner. These are the ones who are crowding on final assembly as fast as possible. Some are spreading the work out to keep going as long as possible.

Chrysler Corp. has the same story. Only truck lines will be operating after the fifteenth. Some of its machining operations will also continue but 60,000 will be affected by its shutdown.

The smaller companies are in the same position. Their continuance is dependent on receiving parts from suppliers and the freight embargo is choking off the trickle of goods which might keep them going.

What the coal strike isn't doing, strikes in suppliers plants are. Nothing is in balance and nothing appears likely to be. The shutdowns will not be short ones, the industry believes. It may last longer than any previous one since the GM tieup.

Suppliers' strikes, far from being over with the granting of wage increases, have been getting worse. Ford Co. for instance revealed that 35 of its suppliers were out on strike. Pontiac division of General Motors had 15 with labor troubles. The other companies are in about the same shape.

With freight movements being curtailed by the coal tieup, those who do not ship by truck will have more difficulty in getting parts to their customers.

Immediate Prospect Gloomy

On the other hand, the far view is fairly optimistic. Should the strikes and other troubles, by some miracle, be ironed out once and for all, the outlook would be very hopeful.

As the greatest of all the mass production industries, the automobile plants could go from the half-pace to full steam in short order. Everything is in readiness for record production, if everything were in balance again. Cars could pour out of the plants in the third quarter and chew into the mass of orders which have been piling up.

But immediately ahead is trouble. Coal supplies are low and so are steel inventories. The declining use of steel capacity means that even with the end of the coal strike, it would be some weeks before sufficient production could be expected on the types of steel used in automobile production. The lag would affect thousands of workers in the industry.

1947 Studebaker Repercussions

Studebaker's bold venture into the 1947 models after running off only 24,000 of the 1946 lines has caused considerable discussion. It is a multi-million gamble against heavy odds, because of the precarious supply and pricing situation.

It puts the other companies into a peculiar situation, too. Most of them have been committed to the policy of continuing their 1946 lines until the end of the year. With Studebaker bringing out a real post-war model (see AM, 5/9/46, p. 148d), with striking lines and advanced styling, the question is whether the others will stick by their resolve.

The power plants are the same as in the 1946 lines, the 80-horsepower in the Champion and the 94 in the Commander, both sixes. A new braking system has been installed which permits adjustment by a simple mechanism which automatically moves the brake shoe outward in steps of .005 of an inch. The propeller shaft has been built in two sections of one unit and box section frames are claimed to be stronger.

ORDER LAG CURTAILS RAIL EQUIPMENT MAKERS

BUFFALO—A lull in the railroad industry's car building and repair program is adversely affecting operations in Buffalo area plants of railroad-equipment makers.

The Symington-Gould Corporation's plant in Depew has been forced to withdraw one of its three open hearth furnaces and has laid off about 250 workers, cutting its force to around 900.

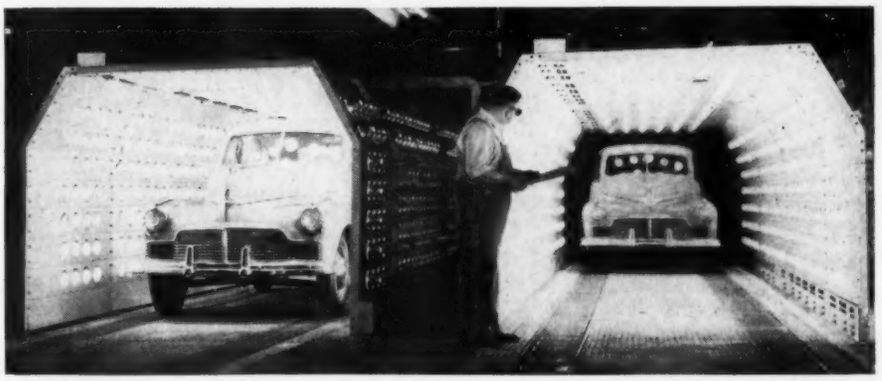
"We have been forced to curtail our production principally because of the lag in incoming orders for railroad car equipment," said Manager Daniel P. Murphy of the Symington-Gould plant.

The Buffalo plant of Pratt & Letchworth has been able to keep operations only around 50% of capacity since last November. It has only one furnace in operation and a company spokesman said orders were coming in slowly.

Stout's Experimental Car

William B. Stout, the left-winger of the industry, has come out with a revolutionary idea in a fiber-glass plastic body for a variation of his famed Scarab car (see page 166).

While the car he displayed had a Ford V-8 engine for motive power, Stout said he had a die-cast pancake engine ready to go into the new car. As usual, Stout has no interest in producing it. The patent rights belong to Consolidated Vultee and Graham-Paige has the manufacturing rights. "I am a plane builder," says Stout. "I am merely interested in bringing out a better automobile. This is not a new car. It is merely a trend that is bound to come."



Cutting Paint Touchup Process by Two-thirds—These assembly-line installations of infra-red light ovens dry primer coats of paint at the Studebaker plant. The 32-foot ovens contain 800 lamps each, on 20 parallel circuits. The infra-red light heats the metal, thereby drying paint from inside out, assuring a permanent base for the enamel. After enamel is applied, the surface is baked in a conventional steam tunnel-oven

British Machine Tool Builders Face Promising Domestic, Foreign Prospects

LONDON—In a development similar to that in the United States, British machine tool builders are facing a rosy future with the prediction that production will be at a high level, possibly at full capacity, for at least three years. The two factors giving substance to such an optimistic view are Britain's all out effort to improve production efficiency (particularly in factories producing for export trade) and a growing export market.

The production drive, backed by trade associations and government officials, calls for new machine tools.

British Exports Up

That the British are moving into the export markets is shown in the January shipments of 1,157 tons worth $1,284,200. The 1945 monthly average, exclusive of exports to Russia which ended in December, was only 484 tons with a value of $502,000.

Moreover, large increases are expected in this year's exports to Europe. France, alone, has a plan for replacing 265,000 old machine tools, of which 125,000 are to be imported from Great Britain, United States and Sweden, or recovered from Germany. In the face of strong American competition, large orders also are anticipated from Canada, India, Australia, South Africa and New Zealand.

Originally, British machine tool builders thought that the availability of large numbers of standard machine tools would vastly curtail postwar production. This was based on the fact that deliveries in 1942—the peak year—were three times the production of 1939 and eight times that of 1935. Further support to such reasoning came from the drop in production during 1944 and the first quarter of 1945. The volume of orders on hand today, however, invalidates this opinion.

Approximately 460,000 machine tools were installed in British factories during the war; about 335,000 were built in the United Kingdom. Of the imported machine tools about 95% came from the United States. Imports from the States in the wartime peak year of 1941 came to 73,676 tons, compared with 11,691 tons in 1938. Of these wartime shipments, 55% were purchased for cash, while lend-lease supplied the remainder (58,000 lend-lease machine tools were purchased outright in January 1945 for $31,500,000).

U. S. Equipment Needed

Imports from other countries declined from 11,930 tons in 1938 to 80 tons in 1941. With the elimination of Germany, which supplied approximately 53% of imports in 1938, from the picture, Britain no doubt will turn to the United States for most postwar requirements, particularly for gear cutters, large presses, die casting machines and specialized automotive production tools.

However, the war-expanded industry will be capable of supplying many standard type machine tools. Furthermore the Machine Tool Trades Association has recommended cooperation between government and industry for designing and building in Britain those special tools which were imported. Britain's ultimate goal is to be independent of foreign markets.

Average deliveries in 1942 were 7,982 per month, dropping to 4,927 in 1944 and 3,988 in 1945. January deliveries totalled 4,002.

After declining from 24,132 tons in 1938 to 7,344 tons in 1941, British exports rose to 32,262 tons in 1944. The increase was accounted for by heavy shipments of presses, punches and shears. In this category, export volume more than tripled 1938 figures. Reduction of shipments to Russia cut 1945 exports to 60% of 1944 volume.

Russian Shipments Halted

Britain shipped 13,086 tons of machine tools to Russia in 1945, compared with 28,544 tons the previous year. Still, the 1945 shipments were 68.5% of the year's total exports. In January there were no exports to Russia.

During 1945, Britain exported 5,926 tons of machine totols to countries other than Russia, the majority during the last quarter. As example, exports to France were 194 tons for the first nine months and 650 tons for the full year, and India took 727 tons, 482 in the last three months.

Much of the fourth quarter increase resulted after Nov. 1 when the government removed restrictions for shipment of surplus machine tools overseas. This did not apply to restrictions, which still remain in force, on exporting U. S. machinery acquired under lend-lease.

TABLE I—PRODUCTION OF BRITISH MACHINE TOOLS AND ANCILLARY EQUIPMENT

Monthly Averages	Machine Tools		Small Tools	Welding Sets				Portable Power Tools
				Arc		Resistance		
	No.	$1000	$1000	No.	$1000	No.	$1000	No.
1941	6744	14,124	8,348	—	—	—	—	—
1942	7982	15,716	11,948	—	—	—	—	—
1943	6350	10,436	14,132	—	—	235	244	38,048
1944	4927	8,588	13,408	720	492	198	172	12,786
1945	3988	6,932	9,404	552	400	205	196	11,097
January, 1946	4002	6,808	—	163	76	88	100	—

Source: British Board of Trade

TABLE II—EXPORTS & IMPORTS OF BRITISH MACHINE TOOLS

	1938	1941	1942	1943	1944	1945
Exports	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
Boring Mills & Broachers	940	456	2,176	1,264	2,540	848
Drill presses	1,776	1,012	1,568	688	724	1,100
Grinding, Lapping & Honing machines	2,944	608	1,680	1,020	3,300	1,612
Lathes, incl. screw & threading machines	5,764	2,380	5,892	3,692	9,424	7,192
Milling machines & Gear Cutters	1,696	572	3,252	1,328	4,648	2,016
Planers and shapers & slotters	1,680	452	844	1,108	2,224	1,232
Presses, punches and shears	584	364	872	804	3,936	1,168
Other types	2,508	1,040	2,204	1,228	4,412	2,976
Total	17,892	6,884	18,488	11,132	31,208	18,144
Imports						
Lathes, incl. screw m/cs	4,316	57,776	34,312	39,180	11,236	2,248
All other types	15,560	92,668	54,172	51,188	21,532	10,956
Total	19,876	150,444	88,484	90,368	32,768	13,204

Washington Bulletin

Nonferrous Wage Boost

A wage increase of 18½c per hour for the nonferrous metals industry (copper, lead, zinc) has been recommended by the Labor Department's nonferrous metals fact-finding board. The board recommends that 5c of this increase be retroactive to Sept. 1, 1945, or the date when the unions demanded the increase, whichever date is later, the remainder to be effective upon resumption of the 40-hour week or July one, whichever is later.

Companies involved are scattered mostly in the Rocky Mountain area, and they produce 88% of the copper, 26% of the lead, and 25% of the zinc mined in this country. Bulk of employees are CIO, some AFL, total 37,000. Companies are being negotiated individually. The 18½c will be a strong influence in settlements, especially since Anaconda has accepted it.

Meanwhile OPA has announced that cost increases resulting from wage adjustments will not affect ceiling prices, but will be met by increased subsidy payments under the premium price plan. Elaborate details are contained in the Labor Department's fact finding board report.

The bill extending OPA's life for one year has an amendment providing price increases of 60% of the original premiums, which would put copper at 15c, lead at 8.15c, zinc at 9.9c. Action on this bill must be taken before June 30, when OPA's life tenure expires.

Surplus Investigation

The inevitable Congressional investigation of surplus property disposal is on its way. Representative Ralph E. Church (Rep.) of Illinois has recommended an inquiry. He would not appoint a special committee for the purpose, but would give the job to the House Expenditures Committee, which advises the Appropriations Committee and other groups on expenditures of the Executive departments of the government. The Expenditures Committee is already inquiring into surplus disposal. Church would formalize it with Congressional authorization and expand its scope. Dissatisfaction with General Gregory's administration of War Assets Administration is increasing. Incompetence in WAA is widely observed, but it is doubtul if the most able management could stop political attacks.

Rebuilding Surplus Tools

WAA is considering a plan under which some of its surplus machine tools not in strong demand would be delivered to tool manufacturers and rebuilders for re-conditioning. Firms doing the work acting as agents for WAA, would sell the tools, with a guarantee, at whatever prices they could get under the used tool ceilings. The rebuilder would receive compensation for the work, plus the dealer's commission of 12% of the Clayton formula price. This proposed program has been under advisement for many months. At this writing a general order had been written and had been circulated within WAA, with apparent approval, but had not been signed by the Administrator. The order draft was read to a recent meeting of the Metalworking Machinery Industry Advisory Committee.

Capital Goods Prices

A responsible price policy official says that OPA plans to finish the decontrol of prices on capital goods in four more orders—five in all including the recent one which suspended control on about $3 billion worth of heavy equipment, and which was followed by the 20% increase on machine tools. Each of the forthcoming orders would uncover an additional $3 billions worth of equipment—$15 billions in all, and would be spaced about one month apart. Machinery groups are pressing for suspension on more machine tools —on all of them as early as possible. Indications are that OPA's tenure will be extended for another year from June 30, with substantial price powers. With the battle for control won in Congress, if it is won, further de-control orders will be relatively free of politics, but at the same time OPA will regard its victory as a mandate to be tough.

TWIN COACH BUS PRODUCTION STARTS WITH BIG BACKLOG

BUFFALO — The Twin Coach Company, which will start producing buses soon at its new Buffalo plant, has a $15,000,000 backlog of business, and practically every major American city has placed orders for the company's buses, President Louis J. Fageol of Kent, Ohio, reported during a visit here.

The first bus to be made in the Buffalo plant, he said, is expected to be completed in June. Schedules call for the production of 250 this year, but this may be increased by 100.

Mr. Fageol declared that the company was fortunate in having placed early orders for material for use in its Kent plant which are being shifted to Buffalo for use in buses. Mr. Fageol said his company is greatly interested in the possibilities of its 58-passenger bus which he indicated may be produced in Buffalo.

Packing English Cars For Export—This scene at the Austin Motor Works packing shop, Longbridge, England, shows the assembly line handling of the crating of British cars for export. This speedy operation, which simplifies handling and reduces space, permits 200 packers to ship 750 vehicles weekly, comprising 622,500 distinct components

Glass and Plastic Form Body for Rear-Engined Stout '46 Car

DETROIT—Wm. B. Stout's "Forty-Six" shows the expected revolutionary application of Fiberglas plastic as a structural material. The entire body is molded in one piece—sides, roof and floor—with reinforcing transverse bulkheads at the dash and behind the rear seat. It's a research project being done by Stout for Graham Paige and Consolidated-Vultee with the cooperation of Owens-Corning Fiberglas.

Walls in many parts of the car and particularly in the luggage compartment door in front and the engine hood at the rear are made from three-ply 1/16-in. thick Fiberglas. This is so strong that it was impossible even to mar the surface when struck with the full force of a 2-lb. hammer swung at arm's length. The material is so elastic that fenders dented by running into another car spring back into shape when the pressure of the impact is relieved. Stout claims the material has a tensile strength of 300,000 psi, and an impact strength ten times that of steel in a crash.

The strength of the material is evident when it is used for the bumpers. They are molded from Fiber glas and attached to the body structure with a thick rubber pad. As they have the same color throughout, they do not show scratches and cannot corrode. Four wrap-around bumpers are used—one on each corner—separated at the center by the width of the license plates.

Stout's New Car—William B. Stout at the wheel of the "Forty-Six," which has a full-width body of Fiberglas. Wheels are individually and pneumatically sprung, chassis and body are a "monocoupe" unit, the engine is behind a rear bulkhead, the luggage compartment in front

Body finish has a high luster due to the use of chromium-plated molds in which it is formed. The color goes straight through the body material, so no painting is required. Repairs can be accomplished, so Stout says, by inserting a piece the shape of the opening and cementing it in place under the action of a heat lamp. Bodies are cured in a heat room at about 235° F.

Curved safety glass form the windshield halves. This construction gives wonderful driver vision but requires a flexible rubber windshield wiper.

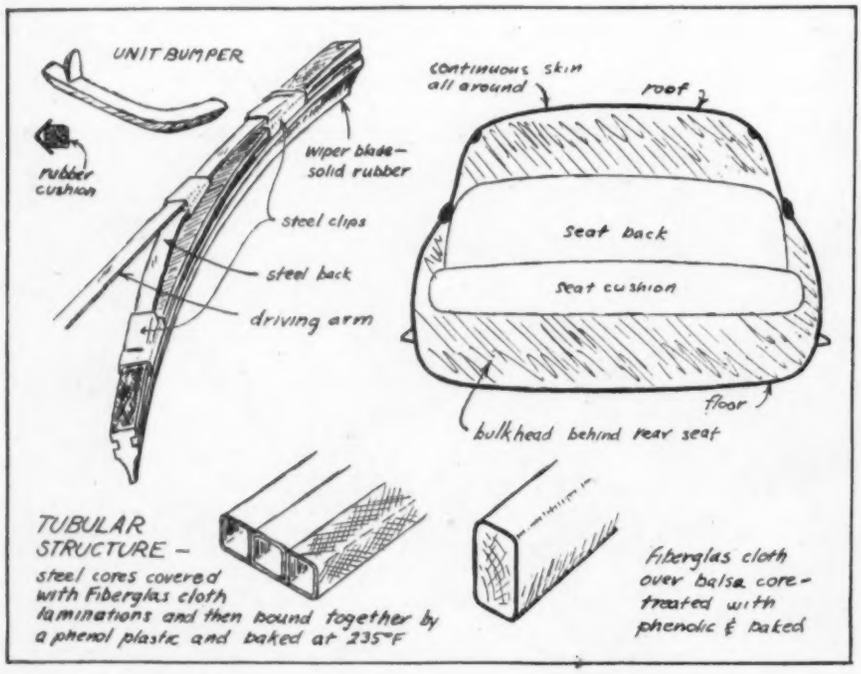
Interesting possibilities in other fields are suggested by the method of constructing some of the reinforcing struts in the body. Fiberglas fabric is wrapped around balsa wood and cured to form a sealed glass-plastic tube of great strength around the balsa core.

The cost of the material, about 75c per lb. now, is one reason why it will be some time before it can be used extensively. The two hour curing time and necessary ovens are so different from current production methods with steel that no change is likely in body building for some time. However, the material cost, so Stout says, may be cut in half by making the glass cloth without a warp just as tire cord fabrics are made today.

The car is about 500 to 1,000 lbs. lighter in weight than a conventional car of similar body room; it has a 6-ft.-wide rear seat that can be made up into a double berth. The body compartment, with a flat floor, is 132 in. long on a 137-in. wheelbase car.

Electric pushbutton latches on the doors eliminate handles inside and outside. The doors cannot be opened accidentally from inside. This means entirely new types of electro-magnetic locks and eliminates the usual hardware for car doors.

Fiberglas is both a heat and cold insulator. Also the body is much quieter; there is no rumble as the car runs over rough roads.



Some Body Innovations—The cross-section of the monocoupe construction at upper right shows rear "seat" and bulkhead. Shape of the unit corner bumper is at upper left with cross-section showing the rubber shock cushion behind it. To wipe the curved windshield required an all-rubber wiper (upper left) backed by a spring to hold it in contact. Structural members are Fiberglas (bottom)

U. S. Steel's Geneva Bid Outstanding; WAA Award Awaited, Kaiser Did Not Bid

WASHINGTON — Considerable interest is centered on the War Assets Administration's opening of eight bids May 1 on the Government's $200,000,000 steel plant at Geneva, Utah, operated during the war by Columbia Steel, a subsidiary of United States Steel. Capacity of this plant is 250,000 net tons of structural shapes and 700,000 tons of sheared plates per year, and its production will materially affect the steel market in the West.

Most likely offer for the plant is that of United States Steel: $40,000,000, payable $5,000,000 down and the balance in two years when the bidder expected the facility could be ready for production. USS also offered to buy the plant's inventories for $7,500,000, payable at the time of transfer. The Company proposed in its bid to spend $18,000,000 on its own account for converting part of the plate mill for production of about 386,000 annual tons of hot-rolled coils, which would be finished in sheet and tinplate at a plant to be built at Pittsburg, Calif., for about $25,000,000.

Colorado Fuel and Iron proposed that if the Government would spend $40,000,000 on additional facilities at Geneva, the Company would then form a $25,000,000 subsidiary which would lease the enlarged plant for 15 years, paying $2 royalty per ton on production. CFI wants an option to purchase when the lease expires, for not less than $80,000,000, the amount to be set by a board of arbiters. Estimated annual production is 500,000 tons. Other bids were regarded by competent observers as unlikely to be accepted.

Competition between Big Steel and Colorado Fuel and Iron may hinge around attitude of the Justice Department, which will review the offers from the viewpoint of trust busters.

Henry J. Kaiser sent in a missive which, upon being opened and read to the attentive gentlemen of the press, of industry and government, turned out to be not a bid but a skilfully-worked plea for re-adjustment downward of interest rates on the RFC loan which financed his Fontana, California, steel plant.

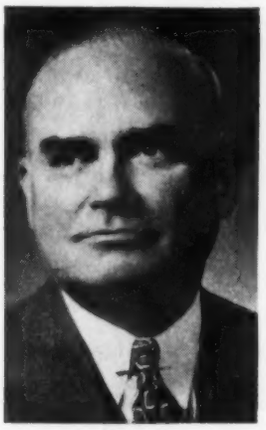
Van Norman Acquires Morse Twist Drill; James Y. Scott, New President

SPRINGFIELD, MASS.—The Van Norman Co. has purchased substantially all of the outstanding stock of the Morse Twist Drill & Machine Co., New Bedford, Mass. Morse will be operated as a separate corporation, remaining in New Bedford. New officers are James Y. Scott, president; James A. Wright, vice president and general manager; E. C. Adams, vice president and assistant general manager; M. J. Rainey, general sales manager; and L. H. Stanton, treasurer.

The new management of the Morse company will further develop the present Morse line of drills, reamers, cutters, taps, dies and special tools.

Mr. Wright, who will have charge of the Morse operations, began his business career with Russell Motor Car Co., Toronto, of which he became superintendent in 1915. After World War I, when he was an Army officer, he was successively assistant factory manager of John Russell Cutlery Co., president and treasurer of the New York Mica Mfg. Co. and director of sales of Indian Motorcycle Co. In 1934 he became assistant to the president of the Van Norman Co. During World War II he served as assistant to the director of the Machine Tool Section of the War Production Board.

James Y. Scott



James A. Wright

Diverse Opinions on Timestudy Presented at S.A.M. Meeting

NEW YORK—Conflicting views of timestudy were presented at the First Annual Conference on this subject, sponsored by the Society for the Advancement of Management, and the Management Division, the American Society of Mechanical Engineers at the Hotel Pennsylvania, April 26 and 27. Representatives of both management and labor were given an opportunity to present their ideas. Every speaker indorsed the objective of industrial efficiency and even of the use of wage incentives to reach that objective.

Harold Engstrom, chief industrial engineer, The American Home Products Corp., spoke on predetermined motion time standards, and deplored the fact that more companies did not apply such standards before getting into production. Improvement in maintenance work, described by Howard A. Estabrook, superintendent, Timestudy and Efficiency, Aluminum Company of Canada, Ltd., covered the conversion of maintenance methods from a war to a postwar basis in the smelting plant at Arvida, Canada.

Management Techniques Dated

Ben S. Graham, manager, Formcraft Dept., The Standard Register Co., stated that office management techniques were 20 years behind factory management standards. Dr. Herbert L. Spencer, president, Bucknell University, addressed a luncheon meeting on the subject of arbitration, pointing out the difference between questions which could be handled in this way and those which could not.

A plan for training timestudy men was offered by Philip Carroll, Jr., consulting management engineer. Such training is the first essential for putting incentive plans on a firm footing according to Mr. Carroll. The vexing problem of determining sound timestudy allowances for material, fatigue, personal or mechanical difficulties was discussed by Ralph Presgrave, vice president, J. D. Woods & Gordon, Ltd.

Samuel L. H. Burk, director of organization and methods, The Atlantic Refining Co., stressed the importance of job evaluation as a means by which management can establish equitable gradients of wage rates based on differing job requirements.

Wartime Developments Featured At Southern Metals Exposition

ATLANTA—New machinery developed during the war years, together with a new type industrial electric fan, highlighted the Southern Machinery and Metals Exposition held here recently. This was the Southeast's first such exhibition, and attendance of more than 7,500 while small in comparison with national shows, was so much larger than anticipated that plans have been laid to make it a regular annual affair.

At the exposition, the Moore Company of Kansas City exhibited a new fan which comes in either ventilating or pressure blower types and in sizes from three to five feet, with a rating of ¾ hp. at 400 rpm. up to 14 hp. at 1800 rpm. The fan is made of cold rolled steel and monel metal, with blades based on the variable pitch aircraft propeller, and will sell from $320 to $400. A feature is the new type of motor, which has a stationary field with revolving rotor. The fan's blades are welded on a spherical hub at the angle required for the speed, volume and pressure.

A yarn abrasion tester, outcome of a testing project undertaken for Avondale Mills, Sylacauga, Ala., attracted attention, as did an electric stud welder, developed during the war for use in speeding up shipbuilding.

Dr. E. N. Kemler of Southern Research Institute exhibited a new heat-pump for home heating and air conditioning. Georgia Tech had on display its electron microscope with a metallography exhibit.

Altogether there were forty-seven major exhibitors, with over one hundred companies and agencies represented. Three industrial forums were held during which prominent scientists, industrialists, educators and business officials were heard.

Part of GE's "More Power to America" program, the film requires about 30 minutes to exhibit. It is available for loan without charge through electric utilities, welder manufacturers and GE offices for exhibition before engineering and manufacturing groups, schools, and others interested in resistance welding.

New General Electric Movie Explains Resistance Welding

SCHENECTADY—Produced by the Rachael G. Wolff Studios, under the technical supervision of the General Electric Welding Laboratories, an all-color sound movie, "This is Resistance Welding," is designed to promote a broader understanding of this process. The film shows the four principal types of welding in this category—spot, seam, projection and flash. The operating principles and advantages of each type are described.

Spotting the Air News

Flying Wing

Most interesting new airplane is the Army's XB-35, so-called "flying wing"—a misnomer, since all wings fly. The XB-35, more properly called an "all-wing" design, has no fuselage, and therefore eliminates the weight and the drag of the fuselage. It was built by Northrop, which began experiments on this type in 1923. Many engineers will agree that the all-wing plane has a good chance of wide adaptation in military and transport aviation, but only in very large sizes. There would not be room in the wings of medium and small planes for cargo and personnel. The XB-35 has a wing span of 172 feet, weighs 162,000 pounds gross, a range of 10,000 miles, high speed, and other favorable performance characteristics. Control is obtained with three sets of flaps: "elevons" functioning as elevators and ailerons; split flaps which when opened create drag and serve as rudders; and drag flaps to slow the machine in landing.

Army Tests V-2

On May 10, at the White Sands proving ground, near Alamagordo, New Mexico, where the first atomic bomb was exploded, the Army fired a German V-2 rocket to an altitude of 72 miles and a distance of 39 miles. The Germans had shot them at England on a curved trajectory, at a height of about 60 miles and a distance of 200 miles. Top speed of the rocket in flight is 3400 m.p.h., while its impact speed is reduced to 2700 m.p.h!

Rockets rising 150 miles and traveling 5,000 miles are possible. Carrying newly developed atomic warheads, they are now our most dangerous potential weapon. On the same day, the Army also fired a new meteorological rocket, the WAC Corporal, which is 1 ft. in diameter and 16 ft. long. This missile reached a height of 43½ miles.

Shortages Hit Industry

The aircraft industry, though deflated to about 5% of its wartime high, is being slowed, to a complete stop in some units, by a combination of shortages in labor, housing, and especially in aluminum sheet and fabric. Much of the trouble is blamed on OPA pricing of textiles. Aluminum sheet in stock, and new production, is being diverted to substitute for steel in housing.

Other Developments

Aircraft Industries Association is studying standardization on airliners of batteries, underwing fueling, greasing fittings, air valves, fueling and air conditioning connections (for use on the ground) water loading, fuel hose, low-pressure oxygen, towing rigs, etc. Further standardization may be expected.

Jack & Heintz light weight automatic pilot may be built at a cost low enough, and in dimensions small enough, for use in personal airplanes.

Navy's Bureau of Aeronautics is bragging about a device to eject the pilot (with parachute) from experimental planes which may fail under stress in tests at transonic speeds (subsonic, transonic, and supersonic are speeds below, at, and above the speed of sound). Navy's invention gives the advantage of having a human observer in the test plane, but the job can be done almost as well, better in some respects, by using radio control, with recording instruments.

Lockheed Constellation In World Service—These low-cost-per-ton-mile planes with a useful range of 3,000 miles have gained greater acceptance in foreign transport use entailing long over-water hops. The cabins are "pressurized" so that passengers enjoy the comfort of an 8,000-ft. "cabin altitude", when the plane is actually at 20,000 ft.

Plant Clearance of Government Surplus Expected By June 30

WASHINGTON—Backlog of inventories on 60-day old requests for clearance of government - owned equipment from privately-owned war plants mounted to $61.3 million on March 31, according to the quarterly report submitted to Congress by the Director of Contract Settlement. Shortage of warehouse space (caused by sale of plants used for storage and by slow sale of surplus property), demobilization of experienced service personnel and strikes were listed as causes of delays.

However, 81% of the estimated plant clearance job has been completed and the entire task should be virtually completed by June 30. Plant clearance requests covering 92% of the total inventory have been received.

Summarizing the settlement of terminated war contracts, the report stated that 37,000 contracts involving cancelled commitments of $9.7 billion were cleaned up during the first quarter. This cut the number pending settlement to 23,900, less than 8% of the 312,000 terminated since the beginning of war production. The value of these unsettled commitments is $24.3 billion. A large percentage of this value is concentrated in the hands of a few contractors.

The pending settlements include 23,400 fixed-price terminations and 554 cost-plus-a-fixed-fee terminations. It is estimated that allowance to contractors for settlement will be approximately $3.6 billion, of which $1.2 billion has already been advanced.

Surplus Tools Reallocated

SYDNEY, AUSTRALIA — Approximately $1,000,000 of surplus machine tools will be reallocated to other government departments under the Munition Department's plan to liquidate stocks required for war purposes. The largest blocks in value will go to Commonwealth Railways ($300,000), Postmaster General's Department ($300,000) and Council for Scientific and Industrial Research ($150,000).

Management Course Offered By U. of Iowa, June 10-28

IOWA CITY—A three weeks management course will be given by the College of Engineering, University of Iowa, from June 10 through June 28. Under direction of Prof. Ralph M. Barnes, the course includes class, laboratory and project work on production planning, plant layout, motion and time study and wage incentives. The course is intended for plant managers, foremen, industrial engineers, analysts and executives.

Names in the News

W. P. Gwinn

F. M. Rich

William P. Gwinn, general manager of the Pratt & Whitney Aircraft division; **Rex B. Beisel,** general manager of the Chance Vought Aircraft division; and **Lauren D. Lyman,** in charge of public relations, have been elected vice presidents of the United Aircraft Corp., East Hartford, Conn.

Francis M. Rich has been elected vice president in charge of operations at Kaiser Company, Incorporated's Fontana, Calif. plant to succeed the late **Peer D. Nielsen.**

Lambert J. Wischerath has been appointed assistant to the president of the Blaw-Knox Company's Buflovak Equipment Div. in Buffalo, N. Y. Also **James J. Beyser** has been made assistant general manager.

Kenneth N. Macomber has been promoted from chief service engineer to chief engineer of the Lapointe Machine Tool Co., Hudson, Mass.

Thomas F. Plummer has become production manager for International Plastic Corp., Morristown, N. J.

E. J. Norton has succeeded **J. N. Bohannon** as manager of the Pottstown plant of the Spicer Mfg. Corp.

Owen H. Wenning has been appointed sales manager and elected a director of the Worcester Pressed Steel Co., Worcester, Mass.

James T. Lockwood has joined the Lonn Manufacturing Co., Inc., Indianapolis, Ind., as vice president in charge of sales.

R. W. Biggs has been named works manager of the Ambridge, Pa., plant of National Electric Products Corp., suceeding **Neil C. Lamont,** who has retired.

Col. Arthur J. Seiler has been elected executive vice president of The Phosphor Bronze Smelting Co., Philadelphia, Pa.

James P. Cunningham has been appointed vice president in charge of production for the Luscombe Airplane Corp.

E. C. Wilson, formerly district manager of Warner & Swasey Company's Detroit office, has been named assistant sales manager with headquarters in Cleveland.

Don G. Mitchell, formerly executive vice president of Sylvania Electric Products, Inc., has been elected president. He succeeds **Walter E. Poor,** newly elected chairman of the board, who had been president since 1943.

Walter R. Fidelius has been appointed assistant chief engineer for the Optimus Equipment Co., Matawan, N. J.

David B. Acker has been named director of manufacturing and **Robert A. Lawson,** assistant general manager, of the Menasco Manufacturing Co., Burbank, Calif.

Irving C. Maust has been appointed to the west coast engineering staff of Foote Bros. Gear and Machine Corp., Chicago, with headquarters in the west coast office in Pasadena.

J. W. Sheffer has been appointed general improvement engineer of American Car and Foundry Co., New York City.

William A. Scheuch, vice president of Nassau Smelting and Refining Co., subsidiary of Western Electric, has been elected president of Nassau to succeed **Frederic W. Willard,** who has retired after 40 years service with the Bell system.

R. S. Stover has been appointed supervisor of the Philadelphia-Washington district of Ampco Metal, Inc., with headquarters in the Wilfred Bldg., Philadelphia.

H. W. Poole has been appointed engineer in the steel mill division and **C. M. Rhoades, Jr.,** has been named engineer in the machinery division of the General Electric Company's Industrial Engineering Divisions.

C. C. McDermond has been appointed representative of the welding fittings division of Tube Turns, Inc., Louisville, Ky., in Venezuela and Colombia, S. A. He, and his assistant, **C. T. McCoy,** will make their headquarters in Apartado 331, Maracaibo, Venezuela.

Henry Olnhausen has been named production manager of Commercial Metals Treating, Inc., Toledo, Ohio, while **L. J. McGrady** has been appointed sales manager.

L. K. Burwell has been appointed treasurer and general manager of The Eastern Machine Screw Corp., New Haven, Conn., succeeding the late **Thomas W. Ryley,** who had served as treasurer of the firm for the past 25 years.

Arthur A. Cambria, chief engineer of the Lapointe Machine Tool Co. for the past eight years, has been appointed New England district manager for the U. S. Broach Co., Detroit. He will maintain headquarters in the district office in Shrewsbury, Mass.

Philip G. Nase has been appointed representative in New Jersey for Advance Pressure Castings, Inc., Brooklyn, N. Y. His headquarters will be in Caldwell.

E. V. Crane, former chief of development engineering for E. W. Bliss Co., has become head of the newly formed department of mechanical engineering of Sam Tour & Co., Inc.

George Pearlman has joined the Biad Powder Metallurgy Corp., Pittsburgh, Pa. as production manager. **Lloyd Kramer** joined the organization at the same time as metallurgist.

R. W. Clansky, former vice president and treasurer, has been elected president of the Standard Forgings Corp.

Walter G. Mitchell has been appointed director of engineering and research for the Independent Pneumatic Tool Co. and **James Perham** has been named chief engineer.

OBITUARIES

Schuyler H. Earl, 69, director and retired works manager of the Gleason Works, Rochester, N. Y., died April 29. He retired in 1944 after 47 years' service with the company.

Milo G. Firestone, 64, treasurer of the Hill-Acme Co., Cleveland, passed away May 3 following an illness of several months. He had been associated with Hill-Acme for 42 years.

Walter Nuttall, 63, general purchasing agent of the Blaw-Knox Co., Pittsburgh, Pa., died May 3. Mr. Nuttall had been with Blaw-Knox for 26 years and prior to that time had been associated with other steel companies.

J. J. Prindiville

John J. Prindiville, 75, president and treasurer since 1914 of The Lapointe Machine Tool Co., Hudson, Mass., passed away April 30. Mr. Prindiville was known for his innovations of much modern broaching equipment. For many years he was in the construction business and also headed The International Engineering Works, Framingham, Mass.

Albert J. Ott, 76, founder and president of The Ott Machinery Sales, Inc., Detroit, passed away April 17. At one time, Mr. Ott represented the Landis Tool Co. and the Bryant Chucking Co. and later organized the Ott Grinder Co. in Indianapolis, of which he was president.

BUSINESS ITEMS

Geroter May Corp. has consolidated its Logansport, Ind. plant with its main plant in Baltimore, Md. The consolidation involves the transfer of Geroter May's entire Air and Hydraulics division to Baltimore.

Horst Metal Works, Buffalo, N. Y., has been formed by Richard and Eugene Horst.

Brown Industries, Spokane, Wash., will set up new plants at Los Angeles, Denver, Seattle, Portland, and Salt Lake City for assembly of lightweight aluminum trailers. The Los Angeles plant will be located at Van Nuys Airport in a leased aircraft building used during the war by **Timm Aircraft Co.**

The E. W. Buschman Co., Inc., Cincinnati, has moved its factory and offices to larger quarter at Clifton and Spring Grove Aves., the former Winton Place plant of **The King Machine Tool. Co.**

Rheem Manufacturing Co. will form the firm of **Rheem de Mexico S. A.** which will build and operate a Mexico City plant to manufacture steel shipping containers, butaine containers, water heaters and other household products to be sold in Mexico and Central America.

The Kentworth Motor Truck Corp., subsidiary of **Pacific Car & Foundry Co.,** Seattle, Wash., has been moved to quarters occupied during the war by Boeing plant No. 3.

Atlas Imperial Diesel Engine Co., Oakland, Calif., has purchased the capital stock of **Modern Can Machinery Co.,** Chicago.

Carboloy Co., Inc., has appointed the **Hawley Hardware Co.,** 1120 Main St., Bridgeport, Conn. as an authorized distributor with **Tom Mitchell** serving as its carbide specialist.

Superior Metal Powder Corp., Toledo, Ohio, has been formed with **Lynn H. Gressley, Ladow Johnston** and **Harry S. Bugbee** as incorporators.

Columbus Porcelain Metals Corp. has been formed at 3760 East Fifth Ave., Columbus, Ohio. Officers include: president, **Gordon W. Lasiter;** vice president, **H. C. Scott;** plant engineer, **Robert Lewis;** and shop superintendent, **George Zelinski.**

Fox Engineering Co., Jackson, Mich., has appointed the **Bert Carpenter Co.,** Birmingham, Mich., as its representative in eastern Mich., northern Ohio, and northeastern Ind.

Warren Telechron Co., Ashland, Mass., has changed its corporate name to **Telechron, Inc.**

Eaton Manufacturing Co., Cleveland, has acquired the **Dynamatic Corp.,** Kenosha, Wis.

Hewitt Rubber Corp., Buffalo, N. Y., has changed its name to **Hewitt-Robins, Inc.,** thereby including the name of its wholly-owned subsidiary, **Robins Conveyors, Inc.**

MEETINGS

American Society for Testing Materials. Annual meeting. Hotel Statler, Buffalo, N. Y. June 24-28. C. L. Warwick, executive secretary, 1916 Race St., Philadelphia 3, Pa.

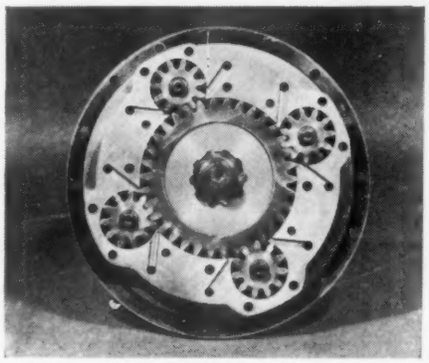
Machinery Dealers' National Association. Annual convention. Claridge Hotel, Atlantic City, N. J. May 29-31. R. K. Vinson, executive director, 20 North Wacker Dr., Chicago 6, Ill.

Metal Powder Association. Spring meeting. Waldorf-Astoria Hotel, New York, N. Y. June 13. Robert G. Kenly, chairman, 420 Lexington Ave., New York 17, N. Y.

Society of Automotive Engineering. Semi-annual meeting. French Lick Springs Hotel, French Lick, Ind., June 2-7. John A. C. Warner, secretary and general manager, 29 West 39 St., New York, N. Y.

Parts and Materials

Brad Foote Drive Absorbs Shocks, Includes Hydraulic Speed Control



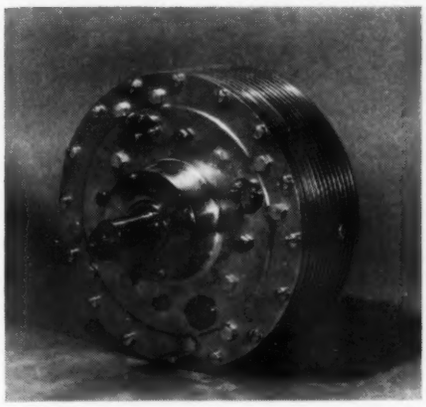
End plate of the housing contains the sun gear attached to the output shaft, and the planet gears which form hydraulic pumps

Clutch and speed control are provided in the Speed Flo Drive built by Brad Foote Gear Works, Cicero 50, Ill. The drive is applicable to machine tools, maritime hoists, vehicles, and other uses. Shocks transmitted through the gear train are cushioned by the fluid in the drive. A torque overload device works automatically to balance shock loads with hydrostatic pressure built up by the gear pumps.

The drive has a reservoir containing oil and air, and the valve and valve seat. The housing containing the reservoir is driven by the engine and even at idling speed rotates fast enough to force the oil to the outside wall of the housing, leaving the air in the center. The output shaft is attached to a sun gear at one end of the unit. Geared to the sun gear are four planet gears which turn on pinions attached to the end plate of the housing. If these planet gears are free to rotate on their pinions the sun gear will remain stationary and the drive will be in neutral. If rotation of the planet gears is slowed or stopped they will turn the sun gear as the housing rotates.

Each planet gear forms, with the sun gear, a hydraulic pump. When the clutch valve is disengaged, air is pumped from the center of the reservoir and returned to the center of the reservoir. As the clutch valve is engaged, oil enters the pumps with the air until at full engagement oil alone is permitted to enter the pumps. At the same time the valve closes off the discharge ports creating an increasing hydrostatic pressure against the gears.

This control permits infinite variation of the output speed from zero to 95% of engine speed. By controlling the valve in the clutch with a centrifugal governor, a hydraulic speed control is obtained.

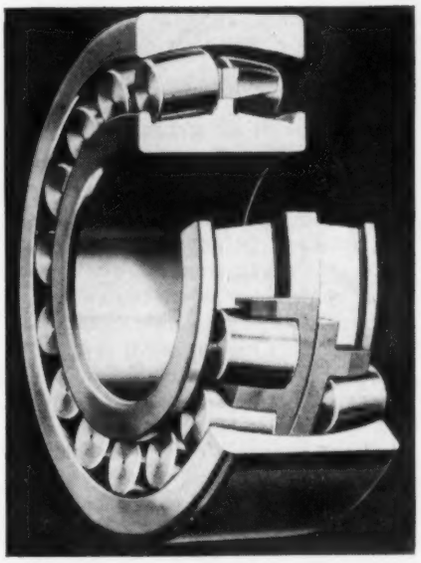


The drive housing contains the reservoir, valves, and gears in a single unit mounted between drive and driven members

Tough Plastic Withstands Acids, High Temperatures, Electricity

A plastic that withstands acids which dissolve gold and platinum and retains its strength and form at higher temperatures than any known organic material has been disclosed by the Du Pont Co., Wilmington 98, Del. This material, tetrafluorethylene resin, will be known as "Teflon." It is already used in jet engines. Limited amounts in sheets, rods, tubes, coated wire, tape, and fabricated sections are available for experimental purposes.

The plastic is an excellent insulating material for ultra-high frequency currents, has a low water-absorption rate, high impact strength, and toughness.



Bantam Builds Spherical Bearing To Suit Heavy-Duty Applications

For heavy-duty performance in machinery, the Bantam Bearings Div., Torrington Co., South Bend 21, Indiana, announces the production of self-aligning spherical roller bearings. Bearings will be produced in sizes from 1.5748-in. bore upward.

In addition to the self-aligning feature, the bearing has two-directional thrust, high radial capacity, high thrust capacity, and unit construction for easy installation.

Cobalt-Nickel Plating Useful On Elastic, Flexible Material

The addition of cobalt sulphate to the nickel-plating bath, assuming special nickel anodes are used, produces a plate that is intermediate between bright nickel and standard nickel in appearance, according to Hanson-Van Winkle-Munning Co., Matawan, N. J.

Cobalt gives a better blue-white color than standard nickel and hence is a better underlay when chromium is added for maximum appearance. The cobalt-nickel process needs no organic brightening agents, which are difficult to filter. When continuous purification is used, it is possible to plate cobalt-nickel 24 hr. per day over fairly long periods of heavy production.

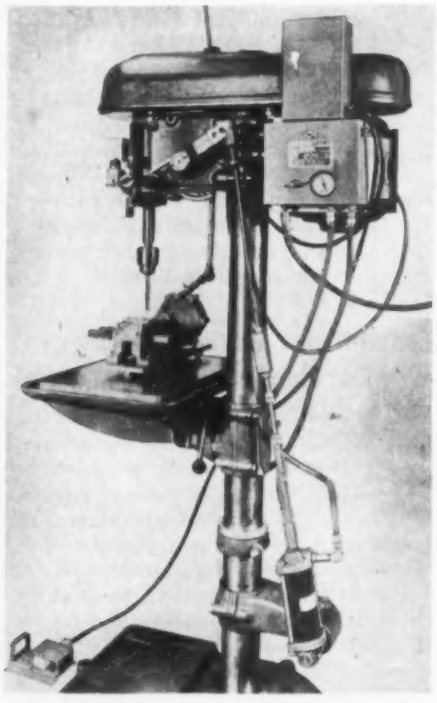
Variations of the process that are available are (1) a soft deposit that

is readily buffed to cover imperfections in the base metal, (2) a moderately hard deposit for plating on brass goods, and (3) a hard deposit with the whitest color and luster for optical goods, food machinery, and tools. Cobalt-nickel is said to produce a satisfactory surface on elastic or flexible materials, such as wire goods, which are difficult or impossible to buff.

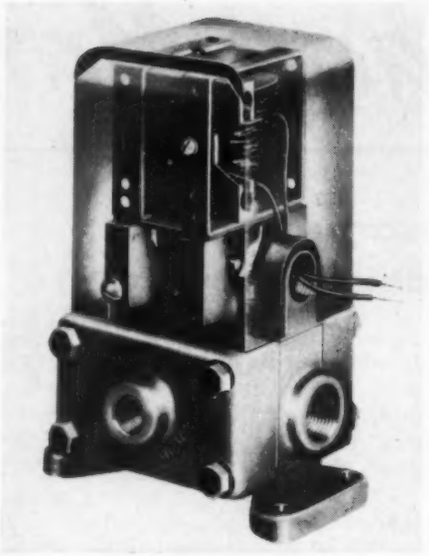
Machines Can Be Made Automatic By Using Electro-Air Controls

A low-voltage control which permits conversion of standard machine tools and fixtures to automatic or semi-automatic production units by pneumatic control has been announced by Electro-Air Devices Co., 2811 W. Fletcher St., Chicago 18, Ill.

The Electro-Air control may be used with any standard air cylinder, can be furnished to provide either single or multiple cycle control with the addition of cycle timing, hesitation limit switches, or other devices, to perform a variety of operations. Operating on 24 volts, the unit consists of a step-down transformer, Enbloc (manifold type) solenoid valves, pressure regulator, needle valves, and armature.



Drill press equipped with Electro-Air control of spindle travel and interlocked vice opening, permitting automatic and semi-automatic operation. Adjustable spindle timing control permits timed deep-hole drilling and enables one operator to handle a number of machines

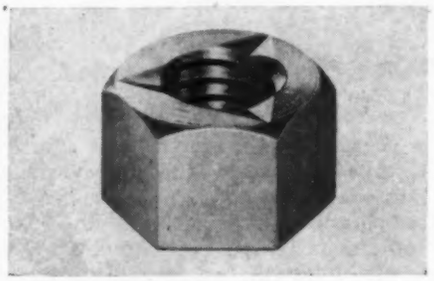


Solenoid-Controlled Air Valve Has Flexible Setup Selection

A solenoid-controlled 3-way valve for compressed air is announced by Numatics, Milford, Mich. Available in six sizes from ¼ to 1¼ in., to handle operating pressures from 0 to 150 lb., the valve operates on the "fluid lever" principle used in the 4-way valves of this company.

The user can select the setup desired by reversing the supply and outlet manifolds on the center body, making it open to exhaust and closed to pressure, or open to pressure and closed to exhaust, with the solenoid energized or de-energized. The value can be mounted in any position.

Travel of the plunger is only 7/64 in. The simplicity of the mechanism is said to tend to eliminate pounding and harsh action, resulting in long life.



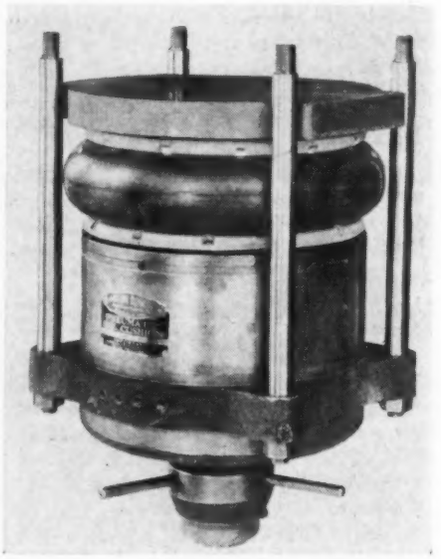
LOCK NUT—Simple, triangular deflection on the top of the nut provides a controlled friction lock on this Gripco lock nut made by Grip Nut Co., 310-C South Michigan Ave., Chicago 4, Ill. With only a wrench needed to apply or remove it, the nut is free-spinning until the bolt threads contact the deflected threads near the top. Tests are said to have shown that the nut can be reused without appreciable loss in locking power.

Rubber Bellows Replaces Piston In Dayton Rogers Die Cushion

A pneumatic die cushion which employs a molded synthetic rubber bellows in place of the conventional piston and cylinder air jack, has been developed by the Dayton Rogers Mfg. Co., 2835 12th Ave. South, Minneapolis 7, Minn. The synthetic rubber bellows absorbs the die cushion travel of the hardened and ground pin pressure pad.

This bellows-type die cushion is said to have flexed in excess of three million cycles without appreciable deterioration of the synthetic rubber molding. It will stand working pressures up to 300 psi.

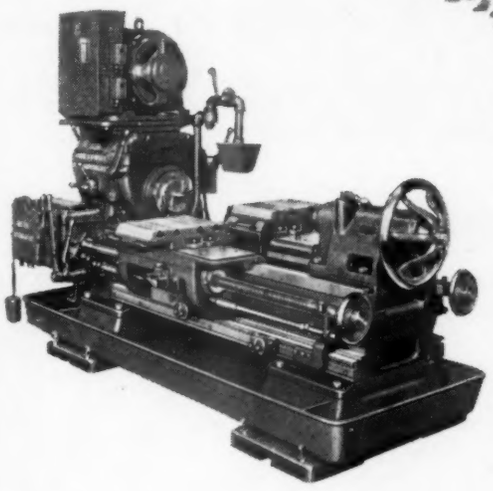
These cushions are made in sizes from 5 to 12 in., having drawing capacities up to 5 in. Off-center loading on the hardened and ground pin pressure pad is compensated for by a heavy-duty guide stem which also serves as an adjustable feature. This allows operator to stop the pin pressure pad at a predetermined height, compensating for bolster plate thickness variation and change in the length of pressure pad pins.



Hot Oxide Dip Protects Gages Gives Clue to When They Wear

Giving gages a hot, black oxide dip, according to Mitchell-Bradford Chemical Co., Bridgeport, Conn., gives them a rich lustrous black finish that does not change them dimensionally, but protects them from rust due to atmospheric moisture or perspiration. As long as they remain dimensionally correct the black finish is unbroken, but if they become worn they show up bright and need reinspection.

The Lathe with a Big "BAG OF TRICKS"



The more jobs one lathe can do the greater the profit possibilities. And if it does work faster, you profit even more. Illustrated are just a few typical jobs among several dozen performed by the 3A Duomatic in one plant. Here are a few reasons why 2A or 3A Duomatics turn out more work—and faster.

1. FULLY AUTOMATIC. Any unskilled operator can handle the most complex multiple tool jobs.

2. NO CAMS TO CHANGE CYCLES. Simple mechanical adjustments make it easy to change cycles—costly down-time for changeover cut to record lows.

3. LIKE TWO LATHES IN ONE. Dual tool slides, front and rear, operate singly or simultaneously. Perform almost any combination of straight or angular "in or out" turning and facing operations.

These are just a few of the many time-saving, cost-cutting advantages of Duomatics. L & S Engineers will demonstrate their adaptability to your work. For additional information, write on your Company letterhead for Bulletins Nos. 601 and 620.

THE LODGE & SHIPLEY MACHINE TOOL CO.

L & S LATHES

MACHINE TOOL DIVISION 3055 COLERAIN AVE. • SPECIAL PRODUCTS DIVISION 800 EVANS ST.

Shop Equipment News

Cincinnati Hydromatics Redesigned For More Capacity, Higher Speeds

For high-speed carbide milling, the line of Hydromatic milling machines of The Cincinnati Milling Machine Co., Cincinnati 9, Ohio, has been redesigned. With heavier construction and larger motors, the machines have increased cutting capacity and higher spindle speeds. Twelve sizes are available in plain and duplex styles, from No. 3-24 (24-in. table traverse, 7½ hp.) to No. 56-90 (90-in table traverse, 30 hp.).

The principal castings are exceptionally heavy, with increased work and fixture area provided by making the tables 2-in. wider. Drive includes gears with wider faces, larger shafts and bearings, and a heavier spindle. Gears are spiral bevel or helical throughout. The bull gear has been increased in size to provide the flywheel effect needed in carbide milling.

A vibration damper built into the overarm arrests vibration at the outboard end of the arbor, greatly reducing the need for supplementary support through the arbor support braces.

A choice of seven ranges of spindle speeds are available. The highest group ranges from 164 to 1225 rpm. for small spindle carriers, 137 to 1000 rpm. for medium, and 110 to 820 rpm. for large spindle carriers. Eight speeds are available within each range.

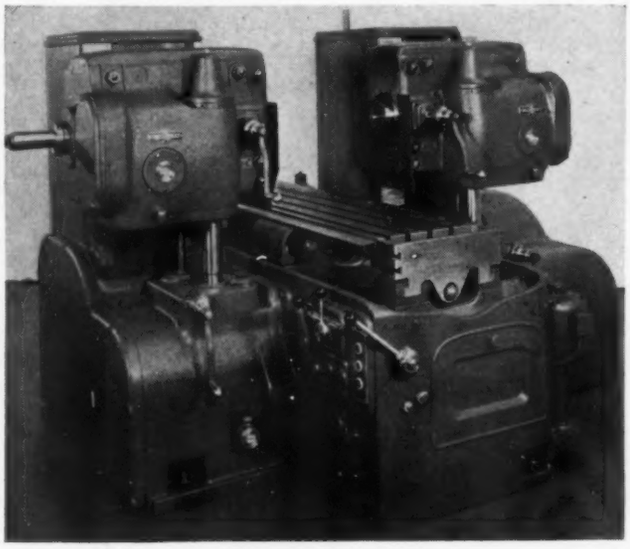
Electrical controls are built into a compartment in the right-hand headstock, the door of which has an automotive-type lock and incorporates a disconnect switch which must be turned off before the door can be opened. A small contact button built into the motor compartment automatically stops the motor when the hinged cover is opened, compensating for carelessness or oversight.

The coolant equipment has a three-way switch, with choice of continuous flow or automatic start and stop with spindle rotation.

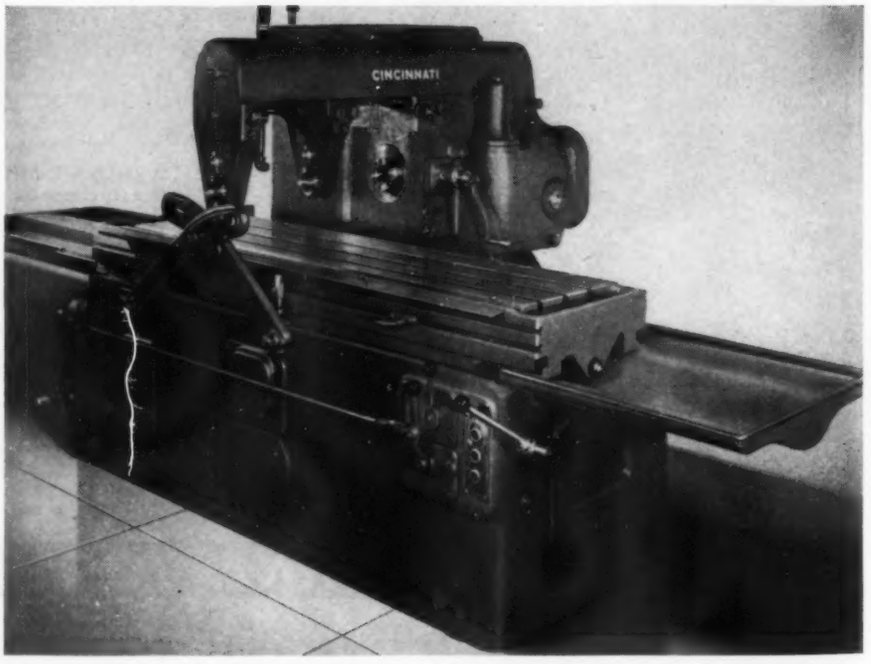
Hydraulics do the work of starting and stopping the spindle rotation on the new models. A small start-stop lever, located in the manual control group, releases the hydraulic pressure which engages and disengages the spindle drive clutch, relieving the operator of much manual labor. Also included in the control lever group are the four-position table-control lever, the table stop, and automatic spindle stop.

Leveling jacks are built into the base, aiding in maintaining alignments, especially on long bed or duplex machines.

With the exception of four minor oil cups (eight on duplex machines) lubrication is completely automatic. Spindle carrier parts are lubricated by a circulating system from a pump and reservoir within the unit. Gears and bearings in the clutch and bevel gear unit are splash lubricated.

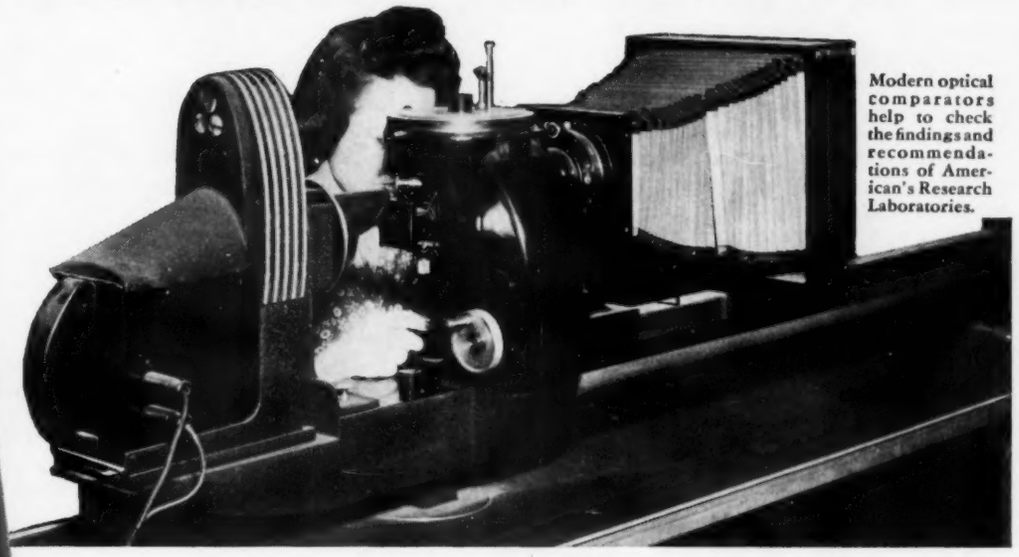


Heavier construction is used throughout the new line of plain and duplex Hydromatic milling machines to fit them for high-speed carbide milling



COME TO THE

"Information Center"



Modern optical comparators help to check the findings and recommendations of American's Research Laboratories.

4-WINGED DRIVER CAN'T SLIP OUT OF PHILLIPS TAPERED RECESS

. . . for recommendations on AMERICAN PHILLIPS SCREWS of the *right type* and *metal* for *your* job

Here in American Screw Company's Engineering Research Department are the technicians, equipment and experience to work out for you, quickly, the right answer to the question: "What kind of American Phillips Screw . . . standard or special . . . is the best one for *my* job?"

The complete American line includes all types of screws, in all the metals listed below. And if your fastening problem involves any of the *rust-resistant metals,* then American's advice is especially valuable. For American specializes in these metals, and particularly in stainless steels of many different analyses.

So bring your problem to the "Information Center," and let American give you extra, *engineered savings* in design and metallurgy . . . in addition to the time-savings (up to 50%) which you always get from the American Phillips Recessed Head: Automatically straight driving, slash-proof protection for work-surfaces, and top speed and ease in handling the 4-winged driver, which fits firmly in the recessed screwhead. Write *now* to the Engineering Research Dept. of:

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AMERICAN PHILLIPS *Screws*

ALL TYPES

ALL METALS: Steel, Brass, Commercial Bronze, Stainless Steel, Aluminum, Monel, Everdur (silicon bronze)

SOLD THROUGH INDUSTRIAL SUPPLY DISTRIBUTORS

Warren City Will Build Presses Introducing Complete Welded Line

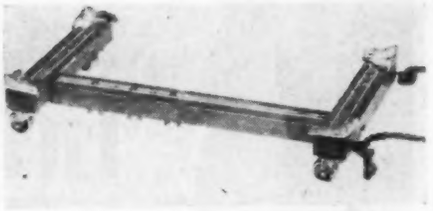
Warren City Mfg. Co., a subsidiary of The Federal Machine and Welder Co., Warren, Ohio, will begin full-scale production of a new and complete line of all-steel welded presses. Present plans are to build a complete line of open-back inclinable presses, ranging in size from 50 to 150-ton capacity, a series of mechanical and hydraulic metal-working presses, with capacity from 100 to 1200 tons, and mechanical press brakes in sizes from 100 to 500 tons designed to handle lengths up to 24 ft.

Eccentric-gear models will be made in both mechanical and hydraulic types. The press frame (solid or tie-rod) will be welded steel, stress relieved to prevent future misalignment.

The slide will be welded steel, guided in long bronze-lined gibways, and adjusted by a motor equipped with a magnetic-type brake for automatically locking the adjustment. Pneumatic cylinders will counterbalance the weight of the slide and dies. The eccentric gear presss will have a stroke range from 8 to 36 in. and a between-housing range of 42 to 156 in. and longer. Die cushions will be available as built-in units, guided in bronze-lined gibways in the bed.

The Warco OBI models will embody construction similar to the eccentric-gear models, affording maximum rigidity. They will have a stroke range of 4 to 14 in. The slide will operate in extra-long gibways necessary for proper die alignment.

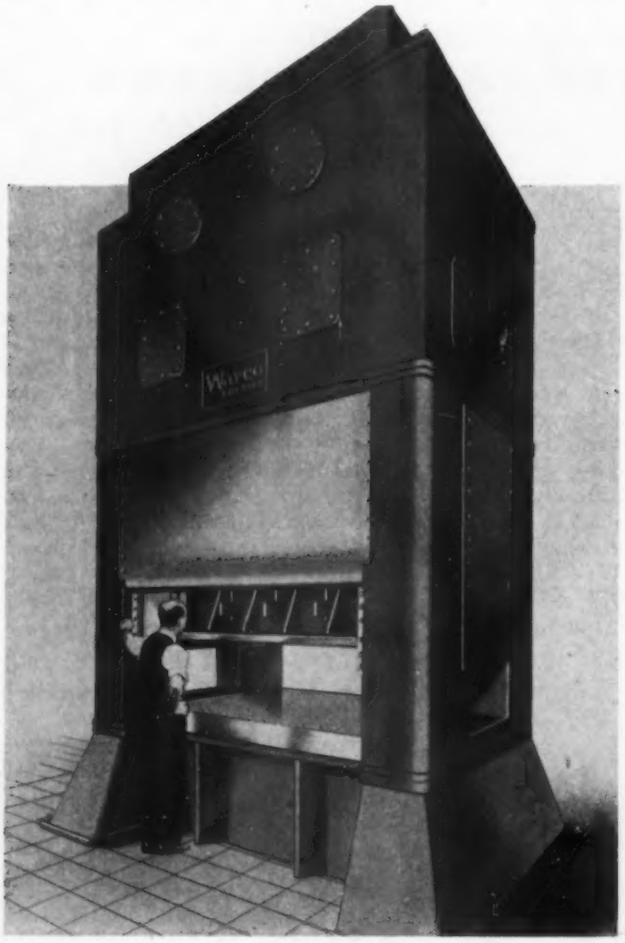
The crankshaft will be made from a high carbon heat-treated steel forging having an extra large crank pin. All crank bearings will be bronze bushed and of split cap design.



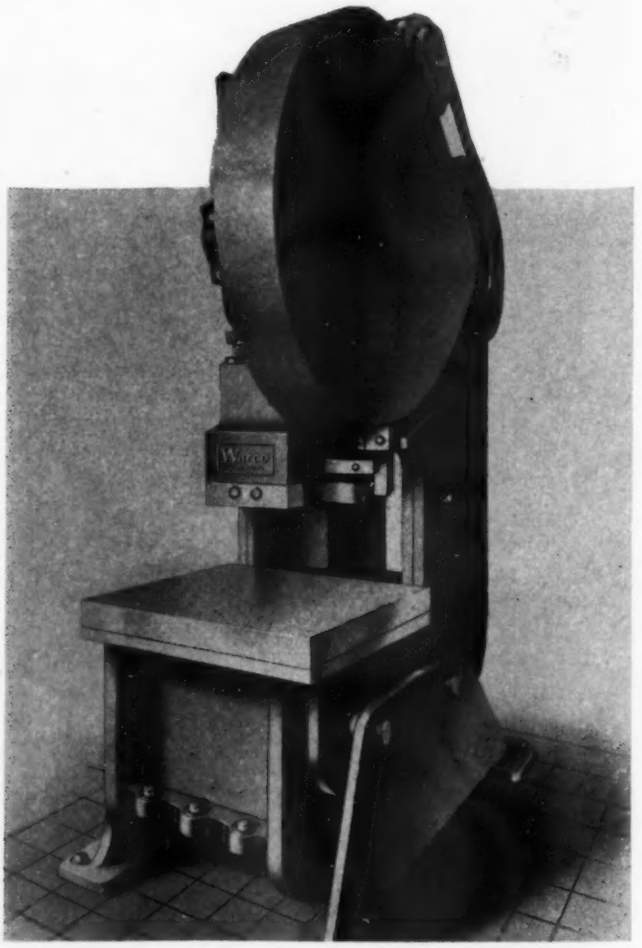
Heavy Tool Chest Moved Easily With Light, Adjustable Dolly

An adjustable dolly suitable for use by machinists and maintenance men in moving heavy tool chests is manufactured by Tool Chest Dolly Mfg. Co., 806 E. Fourth Place, Los Angeles 13, Calif.

The hardwood frame with sliding dovetail strips permits two-way adjustment. Boxes from 7½ x 16½ to 14 x 26 in. can be carried. Designed to carry loads up to 75 lb., it weighs but 2¼ lb. and can be hung on a nail in the tool crib until needed. The light weight is obtained by using the rigid tool box to obtain dolly rigidity.



Warco eccentric-gear models will be double-geared twin drive with bull gears of the eccentric type, rotating on a straight pin. All gears will be steel, the high-speed gears being herringbone oil bath



Clutch and brake unit on the open-back inclinable models will be the same as on the eccentric-gear models. The flywheel, clutch, and brake unit will be mounted on the back shaft between the housing plate and the body

SPECIAL TAPS *can cost less than* STANDARDS

It is frequently more economical to use a special Detroit tap than a lower cost "standard". Reason for this is that DETROIT really designs specials "to the job". At Detroit that means taking into account not only general thread specifications, but characteristics of the materials to be tapped, tolerances required, whether another operation—such as drilling or reaming, or a second tapping operation—can be performed by the same "special".

It would be difficult to determine whether the machines which Detroit Tap and Tool has developed for producing all kinds of specials or the knowledge of tap design problems presented by different materials are more responsible for the outstanding success of DETROIT specials.

Our extensive field engineering force, as well as our Detroit design engineering staff are at your disposal. They will be glad to help you cut machine hours, reduce rejections, eliminate operations and improve the quality of your tapped holes.

Send us a part print of that "tough" job today.

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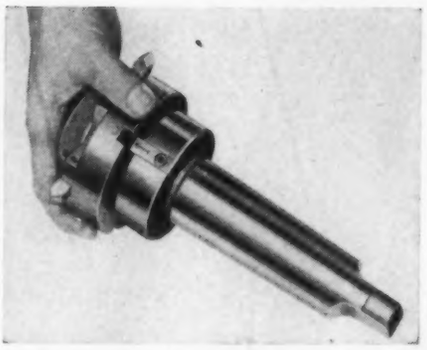
No Distortion on Gear Quenching With Gleason Works No. 16 Press

Gears and other parts are held in quench so they may be hardened without distortion in the No. 16 quenching press built by Gleason Works, 1000 University Ave., Rochester 3, N. Y. A built-in pumping system and oil reservoir reduces the external oil supply to approximately 35 gal. All stages of the quenching operation are automatically set by controls placed at the front of the machine.

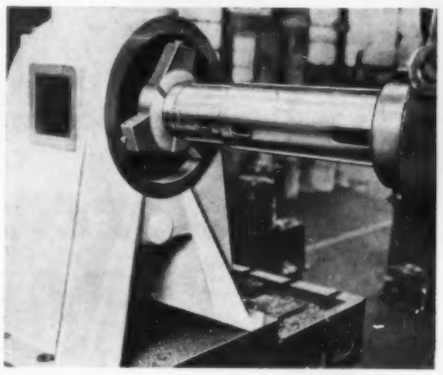
The operator places the hot work on the extended lower die and presses the start button. The lower die is swung back into quenching position and the upper die descends rapidly. As the upper die approaches the work it slows down so that it contacts the hot workpiece gently. After engagement, full pressure is applied to align work while still in the plastic state. Quenching oil flows around the work according to a predetermined sequence of volumes and time intervals. At the end of the cycle, the upper die moves vertically to its position, and the lower die swings out to the unloading position.

Ring gears are held round and concentric while they are quenched by expanding segments on the lower die, within the bore of the gear. These are operated by a tapered expander in a small independently-actuated pilot piston which moves with upper die.

Parts with outside diameters up to 15 in. can be handled in this quenching press. Production capacity ranges from 10 to 120 pieces per hr., depending on the size of section and rate of quench



Three keyways on the head of this boring tool fit in turn on the key mounted on the eccentric arbor so that each tool in turn is brought into position



Boring an 11-in hole with roughing, semi-finishing, and finishing tools in turn. The hole is bored to a tolerance of +0.002 and −0.000 in.

Three Cuts Made From One Setup Using the Kaukauna Boring Head

Three separate cuts can be made without replacing the boring head with the Kwik-Size boring tools made by the Kaukauna Machine Corp., Kaukauna, Wis. Each head carries three single-point boring tools and is eccentric with the tapered arbor, so that only one tool cuts at a time.

The head can be set up with a roughing tool, a semi-finishing tool, and a finishing tool. By loosening the nut at the end of the arbor, the head can be swung about its eccentric pin to bring any one of the three tools into cutting position. There are three keyways in the head which engage with the single key in the arbor.

The tool is of simple construction, consisting of only four major parts. These include an eccentric arbor, a boring head, drive key, and a lock nut. The tools are designed for repetitive boring and are said to be unusually economical for use on any run of work consisting of more than three pieces. When additional cuts are necessary, extra heads may be fitted with tools for counter boring or chamfering operations.

Rigid construction of the tools makes them adaptable to the use of carbide tools. The heads are designed to accommodate standard tool bits of either cemented carbides or high-speed steel. Heads are made in various sizes, each adjustable within a range of ⅜ in. Larger adjustments are possible if less rigidity is desired.

New Hardinge Collet Fixtures For Low-Cost Non-Indexing Use

Two new collet-holding fixtures to provide lower-cost fixtures with stationary spindles for production work where indexing is not required have been introduced by Hardinge Brothers, Inc., Elmira, N. Y. The fixtures are compactly designed with bases machined so they can be used in either the horizontal or vertical position.

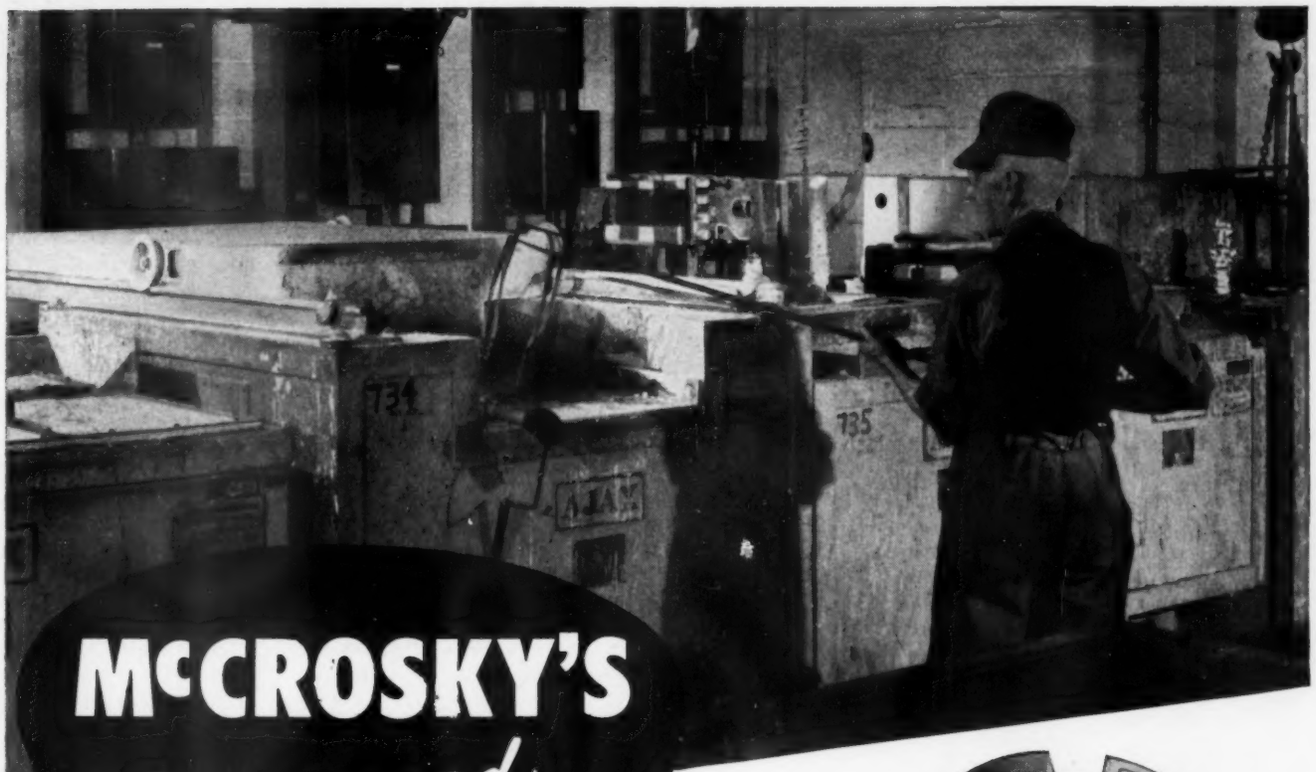
Both fixtures take standard 5C Hardinge collets with a capacity of 1-in. round, ⅞-in. hexagon, and ¾-in. square. The HV-H fixture and the HV-HN are identical except that the HV-HN has a threaded nose spindle. This spindle is made to the same standards as those on Hardinge lathes and second-operation machines, providing interchangeability of nose accessories.

Armor Milling Machine Built For Production or Tool Work

With an adaptability that suits it to machine-shop needs, the armor milling machine built by Aircraft Machinery Corp., Burbank, Calif., is said to deliver accurate and high-speed production.

The machine has a rise-and-fall spindle. The horizontal spindle nose is designed with standard lathe threads externally for lathe operations. It will swing 22 in. Small bar stock can be fed through the taper spindle.

Hand screw feed is standard equip-



McCROSKY'S *Improved* HEAT TREATMENT

assures [illegible] surpassed reamer [illegible] formance

IN this modern, newly installed 200 K. W. battery of salt bath furnaces, McCrosky high speed steel reamer blades are processed through pre-heat, high-heat, quench and draw, producing uniform hardness of the blades without warpage. The alloy steel bodies are isothermal quenched and drawn,—a process that assures uniform grain structure and toughness to resist wear and shock on the job.

Standardize on McCrosky SUPER ADJUSTABLE Reamers. Constantly improved, and made better and better, they will give you a maximum of long, efficient, satisfactory service. Furnished in machine chucking and shell designs. High speed steel, cast alloy, or carbide tipped blades. Write for Bulletin 17-R just issued. It gives full details.

McCROSKY TOOL CORPORATION
MEADVILLE, PA.

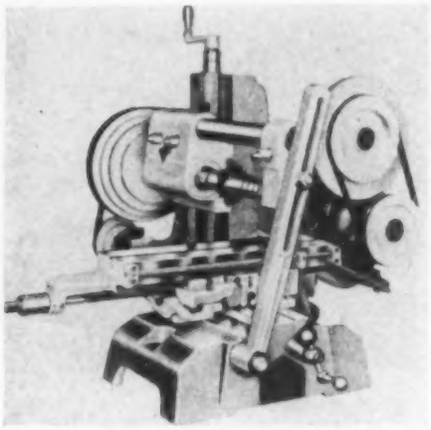
COST CUTTING TOOLS

Designers and Manufacturers of

Jack-Lock Milling Cutters — *Super Adjustable* Reamers
Block Type Boring Bars — *Turret* Tool Posts
Wizard Quick-Change Chucks — *Special* Multiple Operation Tools

ment, but lever feed assembly can be used. The machine has 12-in. longitudinal, 10-in. vertical, and 7-in. cross travel. All three lead screws have accurate micrometer dials.

An automatic power feed is available which drives the table in either direction, independent of spindle rotation, through a totally enclosed, reversible gear box.



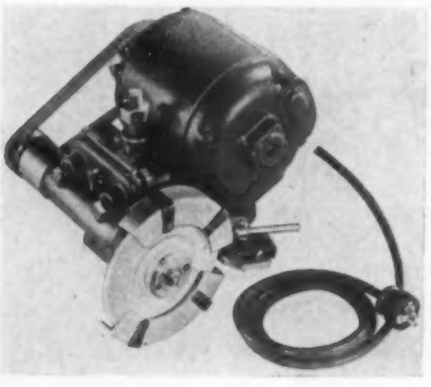
Weighing only 320 lb., stripped, this armor milling machine is adaptable to variety of machine-shop operations

Helix Angles Possible on Three Walz & Krenzer Thread Grinders

A ball-bearing spindle which can be easily adjusted for operations requiring helix angles in thread grinding is used in three Grindall portable thread grinders built by Walz & Krenzer Inc., Rochester 7, N. Y.

The Model M ½-hp. grinder has speeds up to 21,000 rpm. Wheel size for cylindrical grinding is 6 x ½ x ¾ in. hole, for external thread grinding 6 x 3/16 x ¾-in. hole, and for internal grinding diameter to suit the hole to be ground and width up to ¾ in.

The Model R and K grinders are 1 and 2 hp. respectively for heavier work. Any of the models can be equipped with either a V-type or standard Acme thread wheel dresser.



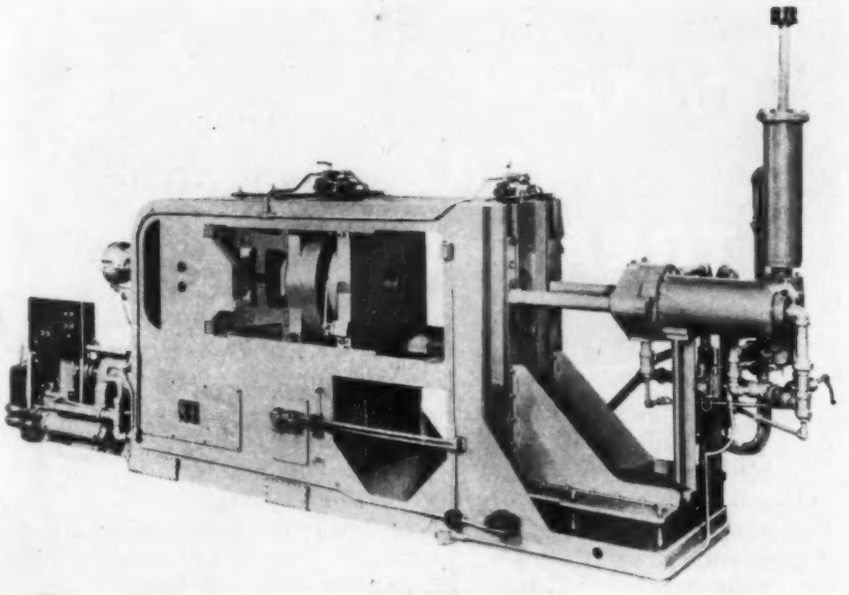
Single Steel Casting Forms Frame On New Lester-Phoenix Die Casters

A one-piece steel casting gives unusual rigidity in two new die-casting machines built by Lester-Phoenix, Inc., 2711 Church Ave., Cleveland 13, Ohio. Model HP-3 ½-SF is for zinc, tin and lead alloys; Model HP-3 ½-X-SF for aluminum, brass and magnesium. The locking pressure possible within this new frame is rated at 600-tons. Dies are lowered through a wide opening at the top which is free from interference.

The central die support has been increased in size, and the movable die plate has bearing on all four corners to prevent deflection as the die is closed. Die movement and die space have been increased 60 percent. Toggle linkage has been strengthened.

The aluminum machine is equipped with an injection system which injects metal rapidly at controlled speed and then applies the greatest pressure to the metal as it chills to squeeze out shrinkage voids, trapped gases.

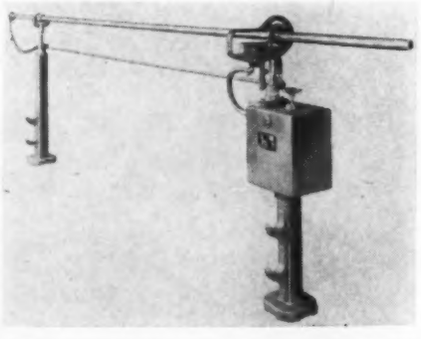
The hot-metal injection system of the zinc machine has a one-piece cylinder and gooseneck of heat-and corrosion-resistant alloy casting, with a high-speed cylinder liner and plunger. Furnace and pot are round, with tangential flames for fast uniform heating. This is said to reduce heat input and heat fatigue of the machine operator. Injection pressure is held upon the metal as it chills in the die. Zinc castings up to 19 lb. can be made.

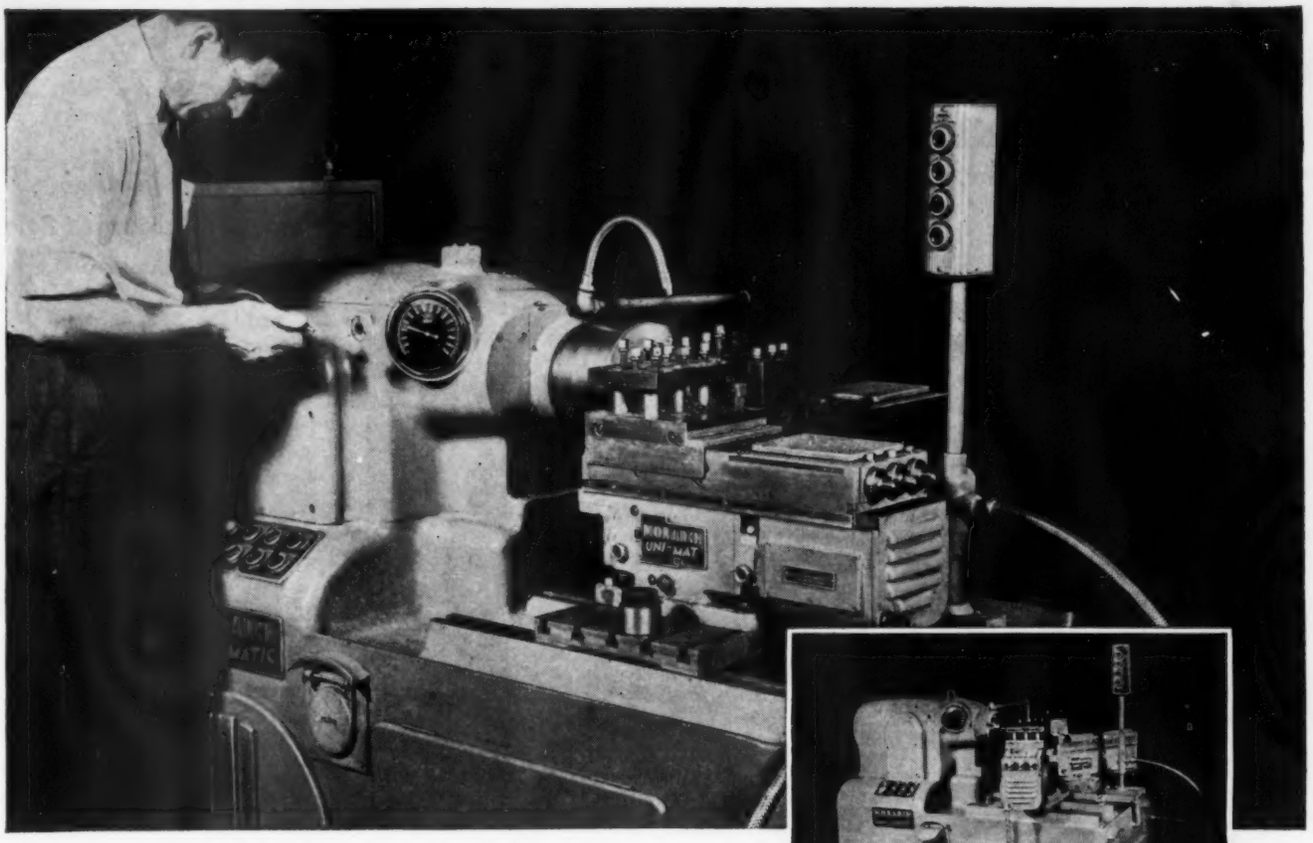


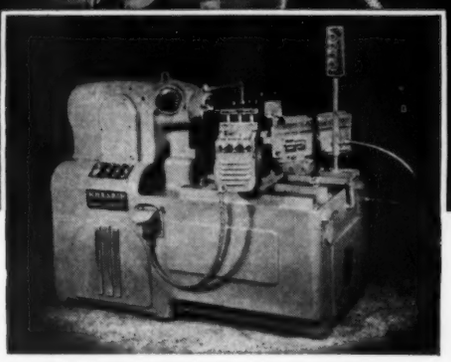
Aluminum castings up to 14 lb. are possible on this die-casting machine. An injection pressure of 33 psi. can be applied to castings up to 40 in. in projected area. Higher pressures are possible with smaller castings

Less Space, Handier Controls For Lipe Pneumatic Bar Feed

Several changes have been made in the pneumatic bar feed manufacturd by Lipe-Rollway Corporation, Syracuse, N. Y. New pedestals with smaller floor space are used on several models, and the control cabinet has been moved to the forward end of the feed cylinder where the operator can make adjustments without leaving his normal position. Two new sizes for small hand screw machines have been added: Model 68, ½-in. diameter x 12 ft. length, and Model 100, ¾-in. diameter x 12 ft. length.







You'll get peak production AT A PROFIT—with the *Uni-Matic**

Spindle speeds up to 5000 RPM. Completely automatic cycle, electronically controlled. Independent-motor-driven interchangeable tool slides ("Uni-Mats") you can position universally, tool universally.

These are just a hint of some of the revolutionary features you'll find in the Uni-Matic . . . for chucking and fixture work as small as 1" and as large as 16" diameter. It's the machine that brings automatic production within reach of every shop, no matter how large or how small the lots.

You'll get minimum machining costs as only you can with specialized automatic production. Best of all, when you change your design you don't change Uni-Matics. Just tailor the tooling to fit your new operation—it's only a few hours' job. The Uni-Matic is universally adaptable.

* *UNI-MATIC* — Add this new name to your metal-turning dictionary—you'll be hearing a lot of it—wherever rising production costs are a factor. The *Uni-Matic* is Monarch's answer to this problem in the field of chucking and fixture work. For between-centers work it's the *Mona-Matic:* for hand screw machine work, the *Speed-Matic.*

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The Monarch Machine Tool Co. • Sidney, Ohio

ACCURACY · ECONOMY · LONG LIFE

Monarch

TURNING MACHINES

Cleereman Jig Borer Redesigned For Accuracy and Convenience

A new jig borer, the Master Model 1836, is announced by Cleereman Machine Tool Co., affiliated with Bryant Machinery & Engineering Co., 400 W. Madison St., Chicago, Ill. A number of changes have been made from the previous design to produce greater accuracy and convenience of operation.

The quill is now made from nitralloy, which in combination with the Meehanite bearing surface of the spindle head shows no measurable amount of wear in two years of continuous use on an experimental model.

The clutch for engaging or disengaging the large handwheel or the fine-feed handwheel to the lead screw is of fine-tooth serrated construction instead of the sliding-key construction previously used. It is instantly engaged at any point by means of a small knurled handknob in the center of the large handwheel.

Rapid traverse is by means of a vertically mounted motor driving an Allen-Bradley electrical plugging switch for braking purposes, the advantage being that there is no mechanical brake to adjust. The fine-feed handwheel is also always free for movement by hand without releasing a mechanical brake.

The cross spindle and quill are now cut for a 24-pitch rack instead of a 12-pitch rack as formerly used. Better rolling contact results in more even and more sensitive feeding. The table has been increased ½ in. in thickness to prevent any tendency to distortion. The thickness of the saddle between the table and the base has been increased 2¼ in. and the ribbing redesigned to reduce deflection when heavy work is placed near the ends of the table. Ways for the table have been lengthened 7 in. so that the table and the way wipers will not run off the ways.

The handwheel for traverse on longitudinal slide has been placed so that all controls are now operated from the front of the machine. The graduated dial remains directly attached to the measuring screw. Net weight of the machine has been increased to 1,100 lb.

New Snyder Railway Wheel Borer Has Increased Production Rate

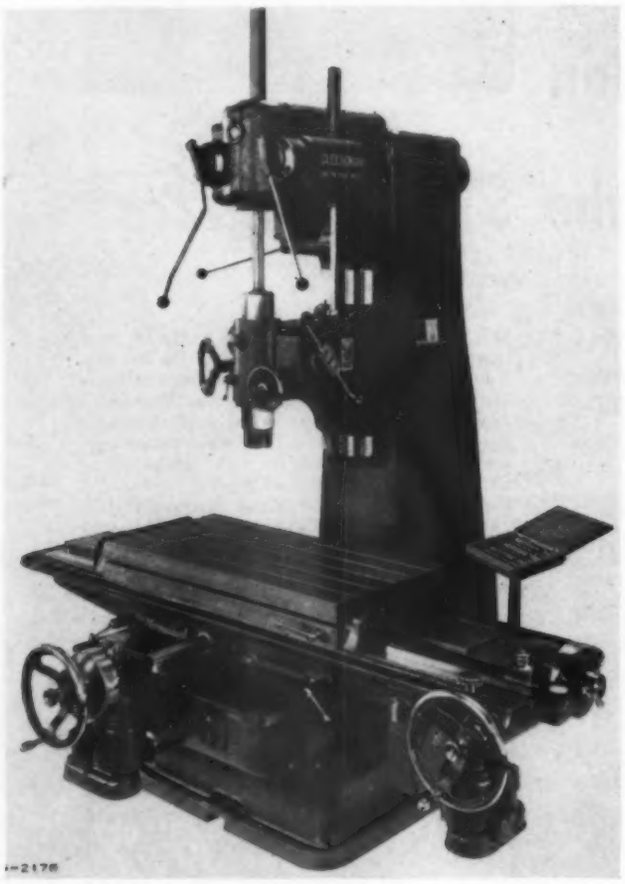
A special-purpose, automatic-cycle machine for rough and finish boring wheels for railroad cars is built by Snyder Tool & Engineering Co., 3400 E. Lafayette Street, Detroit 7, Mich.

Accuracy has been improved and production rate increased on the new machine, which is designed to maintain its efficiency for a 20-year life.

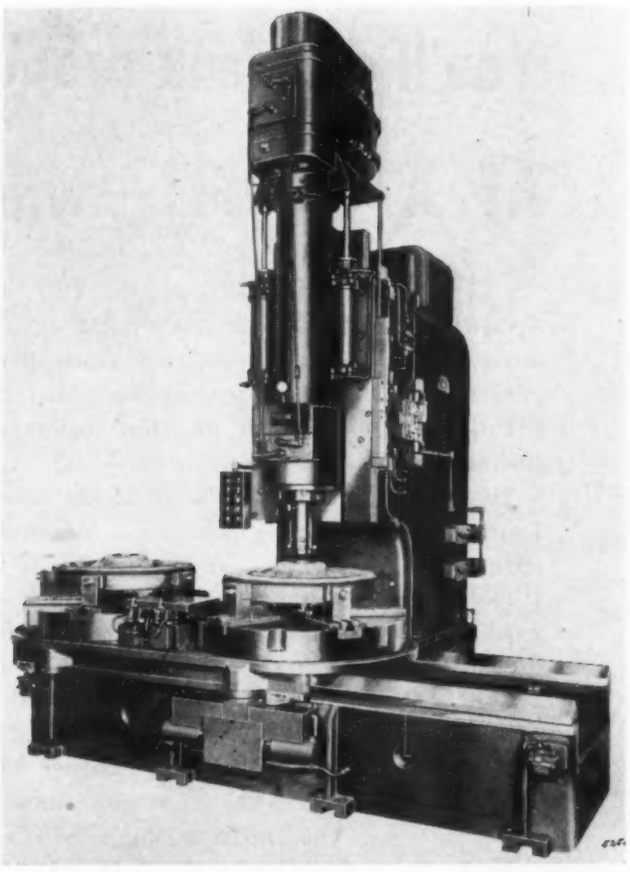
On steel wheels, the cutting time for finish boring ⅛ in. stock per side is 1 min. 20 sec. for a hole 7-in. long and 7-in. in diameter. On cast iron wheels the job is done in 50 sec.

A 19-in. stroke is provided so that rough and finish boring may be performed successively. Chamfering and facing may be performed simultaneously with the boring operation.

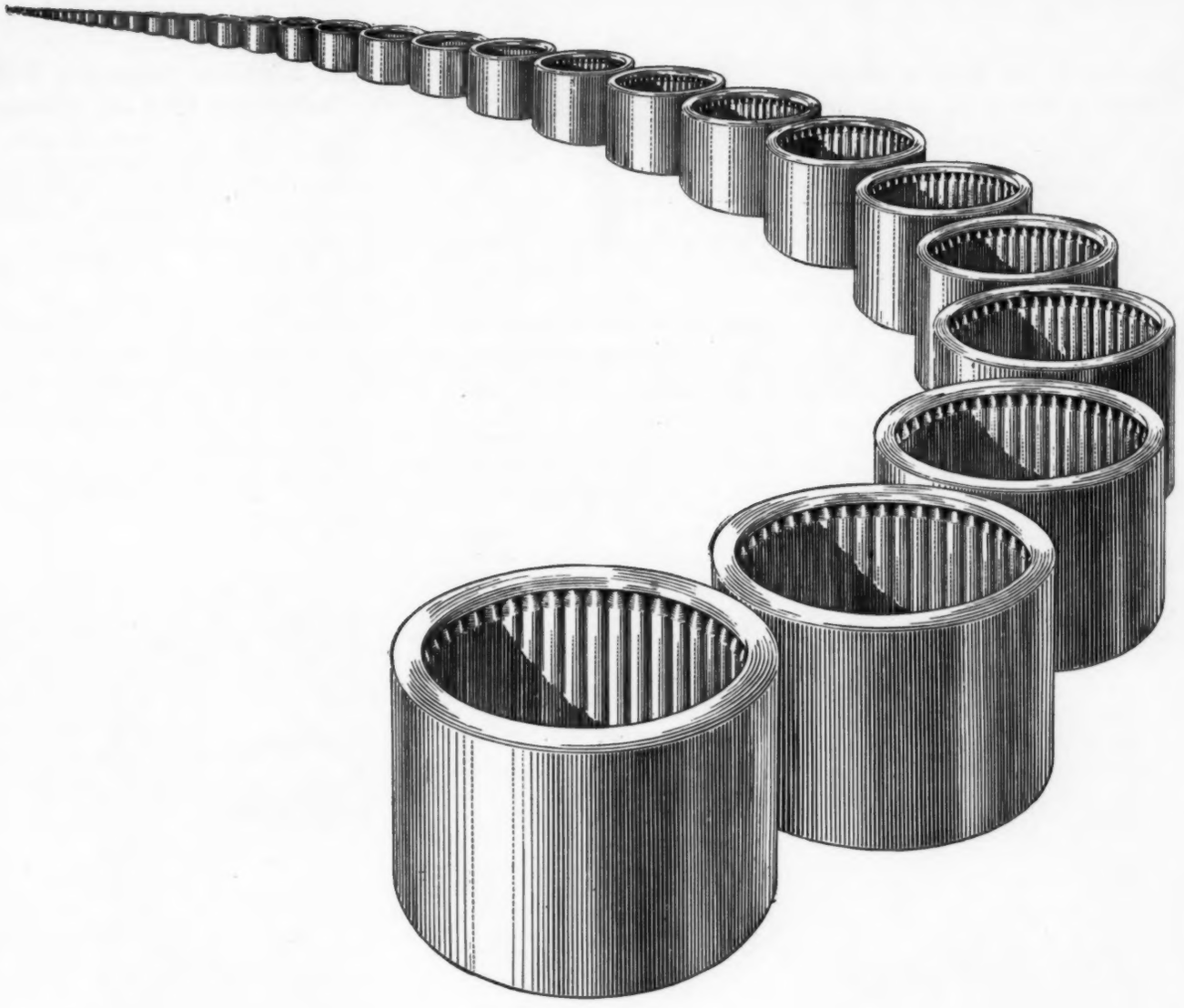
Work is held by two 5-jawed chucks of 42-in. capacity, operated by individual hydraulic cylinders. The work cycle is completely automatic.



Meehanite is used for all important castings in the redesigned Cleereman jig borer, which uses heavier construction throughout to give greater stability



Rough and finish boring tools are mounted close together so that operations are, in part, simultaneous on this machine for boring railroad car wheels



They're cutting operating costs all along the line

Economy of operation is an inherent feature of Torrington Needle Bearings, and it shows up in the form of measurable cost savings all down the line. . . .

In power costs . . . The tremendous radial capacity of Needle Bearings, combined with their low coefficient of friction and equalized load distribution at operating speeds, assures minimum starting and running friction . . . less power consumption.

In lubrication costs . . . The close-fitting, turned-in lips of the hardened outer shell form a reservoir to retain the lubricant and distribute it evenly over all of the bearing surfaces. Thus, less frequent lubrication and maintenance are required, and bearing wear is reduced to the vanishing point.

In servicing or replacement costs . . . Needle Bearings also contribute marked economies. They never seem to need attention, seldom if ever is a replacement required. This is due directly to their design, high load capacity and efficient lubrication.

In your own industry, compact, low-cost Torrington Needle Bearings have solved innumerable friction problems. Our Catalog 32, copy of which is available upon request, will give you a comprehensive picture of Needle Bearing advantages as applied to the machines *you* design, build or operate.

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TORRINGTON NEEDLE BEARINGS

Precipitator for Machine Shops Built in Two Sizes by Raytheon

For use in machine shops and laboratories, the 1200 cfm. precipitator built by the Raytheon Manufacturing Co., Waltham 54, Mass., is said to remove 90% or more of all contaminating particles of dust, smoke, oil mist, lint or pollen from the air. The unit will clean by recirculation the air in a room approximately 35 x 35 x 12 ft.

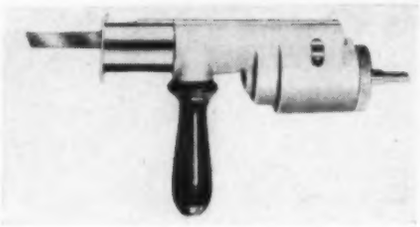
This package unit includes a ¼-hp. motor blower, power pack, and electronic collector cell, all inclosed in a cabinet. Floor space required is 26 x 27 in., with a maximum height of 64 in. The unit operates on 115 volt, 60 cycle, single phase current and uses 50 watts.

With the installation of suitable duct work this precipitator can be used to remove oil mists from high-speed cutting tools. The unit is also supplied in an 1800 cfm. size.

Automatic Cycling Possible With Motch & Merryweather No. 00 Saw

A metal cut-off saw that can be equipped with automatic cycling to both work and feed is built by the Motch & Merryweather Machinery Co., 715 Penton Bldg., Cleveland 13, Ohio. The No. 00 cuts ferrous bars up to 1¼ in., non-ferrous bars up to 2 in., and tubing or shaped pieces up to 2½ in.

Automatic clamping is provided through a spring tension cam-operated mechanism linked to the feed lever. The movable vise jaw is quickly adjustable for different size materials. The saw blade may be run at 160, 247 and 560 surface fpm.



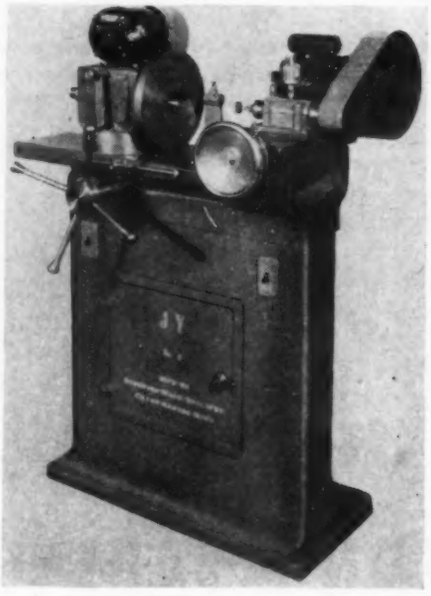
Light Wyco Saw Is Attached To Drill or Flexible Shaft

A saw which can be attached to any ¼ in. electric drill, air drill, or flexible shaft, is built by Wyzenbeek & Staff, Inc., 838 W. Hubbard St., Chicago 22, Ill. The unit can be chucked in a drill chuck or collet. The Wyco Hy-Speed saw uses ordinary hack saw blades and standard ¼-in. shank machine files. A square plunger is used with provision for adjustment for wear.

Superior's Internal Grinder Is Designed for Toolroom Use

Suited for toolroom work, a new precision internal grinder is announced by Superior Machine & Tool Works, 528 Butterworth St., S. W., Grand Rapids, Mich. The JY-No. 2 will grind sizes from ¼-in. diameter up. Spindle speeds are 12,000 to 27,000 rpm., and workhead speed is 200 to 400 rpm.

The machine has a 10½-in. swing with an 11-in. longitudinal travel. Friction drive clutch and hand lever puts machine out of gear and applies brake to measure the work. Floor space needed is 36 x 68 in.

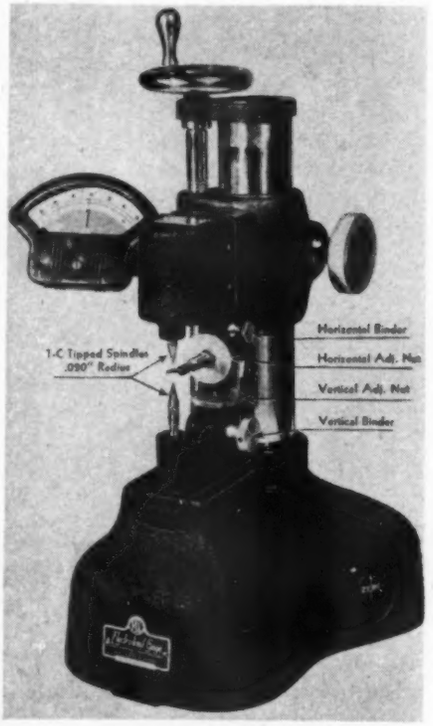


Pratt & Whitney Comparator With Ball Gaging Anvil and Backstop

Pratt & Whitney, Division Niles-Bement-Pond Co., West Hartford, Conn., announces the Model CE-699 Electro-limit external comparator equipped with a special gaging spindle, anvil, and backstop for the inspection of balls.

The gaging spindle and anvil are identical pieces having a tungsten-carbide gaging tip with 0.020 radius. The backstop is a tungsten-carbide Vee located in the anvil fixture with provision for both vertical and horizontal adjustment.

The meter can be graduated in 0.0001-, 0.00005-, or 0.00001-in. increments.



Lincoln Carbide Measuring Wires Retain Accuracy For a Long Time

A complete line of thread and gear-measuring wires made of cemented carbide is announced by Lincoln Park Industries, 1719 Ferris Ave., Lincoln Park 25, Mich. Supplied in sets of three contained in glass bottles, wires for N.S. 4 to 36 pitch are available from stock, others on special order. The wires are ground and lapped to standard tolerances closer than National Bureau of Standards Specifications, with accuracy retained at least 50 times longer than with steel wires, according to the manufacturer.

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4. **Prices that are fair and competitive.**
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These essentials spell Quality. Revere offers them all, because only all five can win and keep customers who are satisfied and loyal. Since 1801 Revere has constantly increased its measure of service to American industry, and now has the largest number of customers in its history. Are you one of them?

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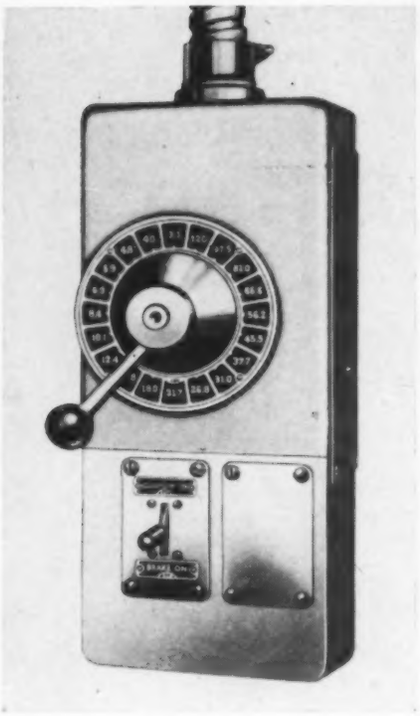


Desired Speeds Are Dialed With Bullard Pendant Control

A new pendant control is now available on all Cut Master vertical turret lathes made by The Bullard Co., Bridgeport 2, Conn. A swinging arm carrying the pendant is mounted on top of the machine high enough to permit full clearance of vertical heads when they are in maximum high position. The pendant is located at a convenient operating height and may be swung to any desired position.

When the machine is in operation and a speed change is desired, the switch lever is thrown into brake position, the change of speed dialed and the lever thrown back into clutch position. Gears are shifted through electrically controlled, hydraulically operated mechanisms. The switch lever may be used for jogging.

Rotary Drill Used on Masonry Has a Cemented Carbide Tip

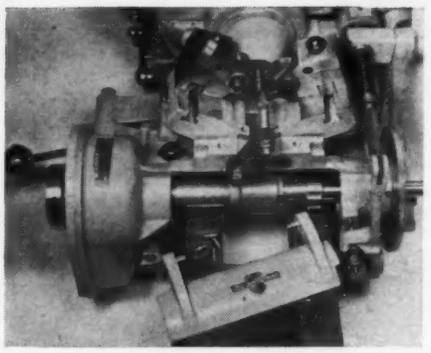
To drill holes in masonry a carbide-tipped drill bit has been developed by the New England Carbide Tool Co., 60 Brookline St., Cambridge, Mass. These drill bits are said to drill holes 50% faster and to last 50 to 75% longer than high speed drills. An ordinary rotary electric drill is used, eliminating the hammering ordinarily necessary to drill masonry.

The drills are made in stock sizes starting at 3/16 in. and going up by sixteenths to 1½ in.

Small Parts Made Automatically With Dunamatic Lathe Attachment

A lathe attachment (right) that gives means of producing small parts automatically on Atlas or Logan Lathes is built by Dunn Engineering Co., 6341 Lyndon Ave., Detroit 21, Mich. The Dunamatic attachment employs the use of face cams to control operation of rocker arms which, in turn, control the operation of form and cut-off tools attached to them. Either circular or flat form tools or a combination of both may be used. The rocker arms operate on pivots instead of slides which is said to eliminate the necessity for constant adjustment.

The stock is cam fed through a tube by feed fingers, into a collet, automatically. A moving stock stop determines the length of the part to be formed or cut off. Closing of the collet is also automatic and is timed to coincide with start of operation of the tools.



Carbide-Inserted Compacting Dies Last 20 Times Longer Than Steel

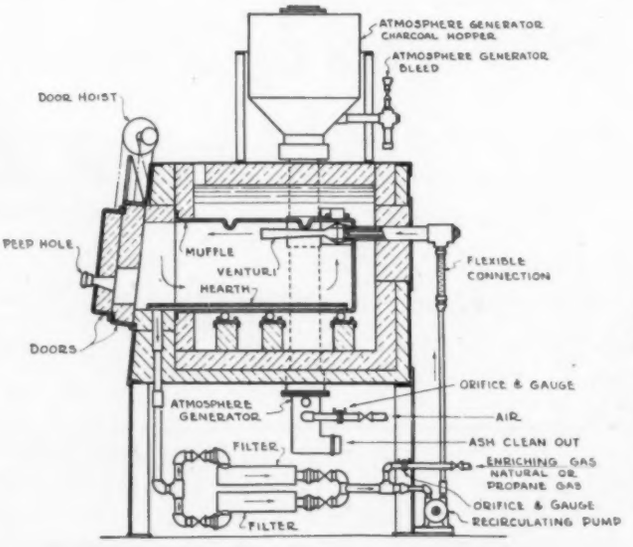
A line of carbide-inserted compacting dies, called Malta, is being made by the Jessop Steel Co., Washington, Pa. Production is said to be more than 20 times that obtained with steel dies. Dies are furnished in sizes from ⅛-in. solid drilled dies, guides, and bushings, to 36-in. inserted drawing dies.

Surface Combustion Furnace Uses Novel System of Enriching Gas

Increased flexibility in handling different batch type heat-treating operations is provided in a new atmosphere muffle furnace built by Surface Combustion Corp., Toledo 1, Ohio. The furnace can produce the proper atmosphere for gas carburizing, yet also is applicable for general heat-treating.

Instead of circulating all the gas in the muffle through the enriching system, thus tending to cool the entire amount, only about 10% is removed from the muffle at any time. This gas is withdrawn near the door, filtered to remove any free carbon. The enriching gas is added through a metering orifice. The gas then passes to the recirculating pump and is discharged at high velocity into a venturi within the muffle, drawing into the venturi a large volume of muffle gases. These are mixed in the venturi and recirculated.

Conversion from a carburizing to a heat-treating atmosphere can be made quickly without shutting down. A twin filter unit permits filter cleaning without shutting down. The manufacturer suggests using the unit for hardening work during the day, and as a carburizer at night.



Only a small part of the gas is withdrawn from the furnace for enriching. The enriched gas enters the venturi at high velocity drawing muffle gases through the venturi and mixing with them

By any measure, the best in special shape blanks is Carboloy Cemented Carbide! This "hardest metal made by man" is ideal for tips or inserts on tools, gages, cams, guides, work rests—any part or product subject to abrasive wear.

Made to your exact specifications, Carboloy Special Blanks are supplied ready for brazing into place, and grinding to final dimensions is simply a matter of stock removal measured in thousandths—then the part is ready for use.

Modern, Carboloy-engineered forming methods make fabrication, to practically any size or shape, a fast—accurate—economical operation, and the savings are passed on to you. Send for free catalog GT-175R.

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WENDT-SONIS REAMERS

with
FULL LENGTH
CARBIDE FLUTES

PRODUCTION DATA REPORT

Name:	Delta Manufacturing Company
Address:	Milwaukee, Wisconsin
Tool:	Wendt-Sonis Carbide Reamer. Carbide full length of flute.
Job:	Reaming Pulley Wheel Hole. S.A.E. 6150 steel. Super finish required.
Speed:	935 RPM.
Feed:	.006" feed per revolution.
Results:	Averaged 8000 holes per grind → holds size — super finish.

All standard sizes available with straight or tapered-shanks

8,000 holes per grind with NEW IMPROVED WENDT-SONIS REAMER

THESE new type reamers are designed to reduce rejects, speed up production and save on tool costs. Their *full length carbide flutes:* (1) eliminate "wobbling" commonly caused by wear on steel flutes, (2) possess greater resistance to wear than flutes with carbide tips only. Maximum flute bearing surface in bushing assures perfect hole alignment and long service life. WENDT-SONIS COMPANY, HANNIBAL, MISSOURI, PACIFIC DIVISION: 580 NORTH PRAIRIE AVE., HAWTHORNE, CALIFORNIA.

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CARBIDE TIPPED CUTTING TOOLS

BORING TOOLS • CENTERS • COUNTERBORES • SPOTFACERS • CUT-OFF TOOLS • DRILLS • END MILLS • FLY CUTTERS • TOOL BITS • MILLING CUTTERS • REAMERS • ROLLER TURNING TOOLS • SPECIAL BITS

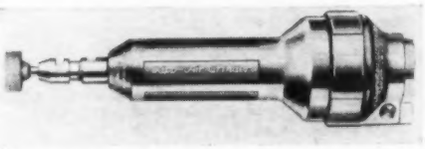
Light Shed on Uneven Surfaces By Yankee Visual Surface Gage

A new type of automatic visual surface gage, developed by the Yankee Precision Products Co., 595 New Park Ave., Hartford 10, Conn., measures the flatness of machine surfaces to close tolerances. While the nature of the work will determine to a certain extent the accuracy, test recordings on typical pieces are said to have indicated that variations of as little as 0.000005 may be measured.

Buttons closely spaced on the work table of the gage duplicate the form and area of the piece to be gaged. The tops of these buttons are accurately ground and lapped to form a perfectly flat resting surface, and each button is connected to a small bulb in matching position on the base of the gage. When the work is laid on the surface of the gage all of the bulbs light if the surface is perfect. Where high or low spots appear, the bulbs in matching position do not light. The percentage of inaccuracy for each segment of the gage surface is indicated on an electric meter.

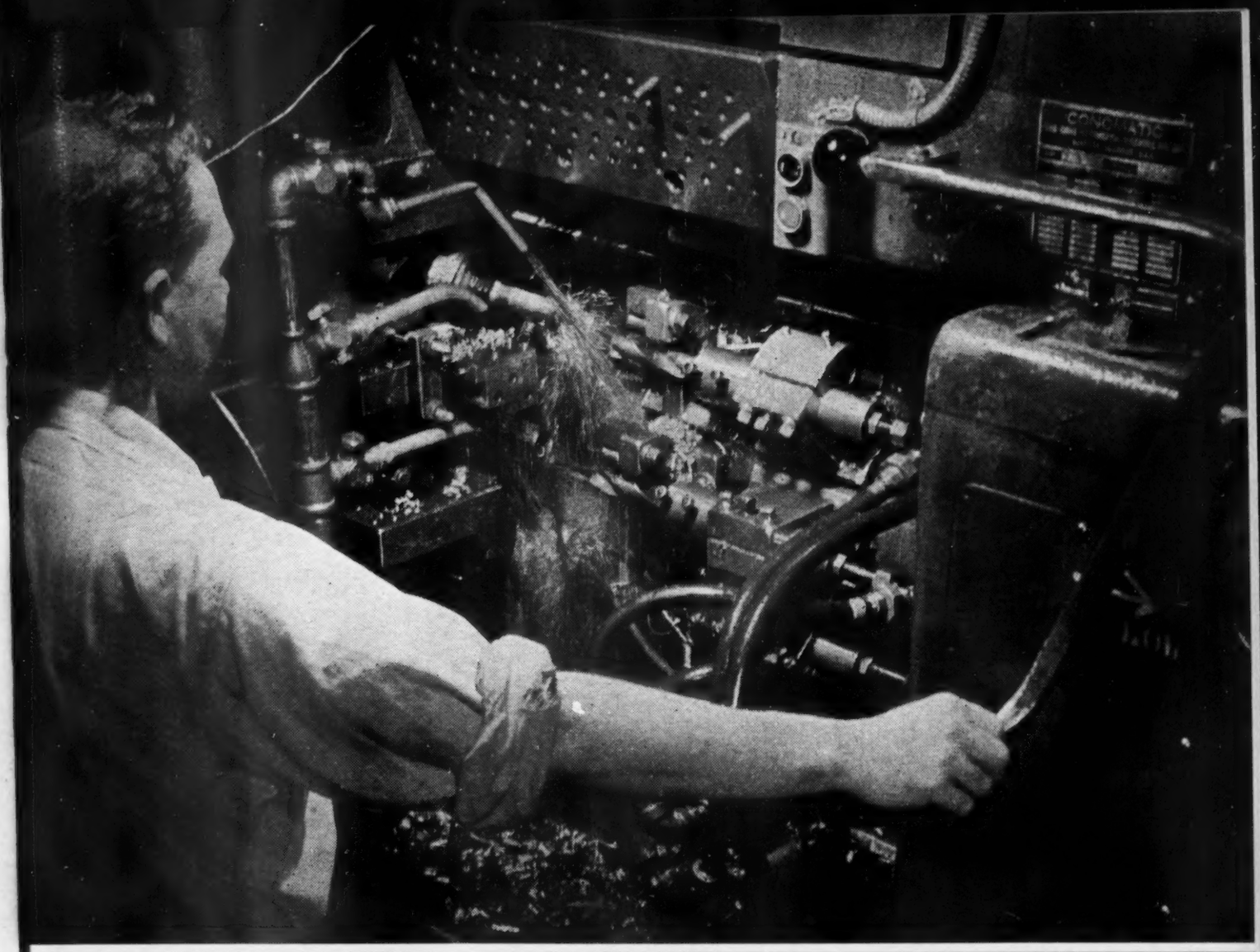
The principle can be adapted to portable plugs, the measurement of tapered bores, and gages for irregular surfaces or contours.

Air Grinders Use Light Metals For Featherweight Construction



New Featherweight grinder models have been introduced by the Madison-Kipp Corp., Madison 4, Wis. The light weight of this series results from using aluminum and magnesium for such parts as housings, back plates, rotors and lock nuts.

The Model JA is a turbine-type



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Used as Machine Lubricant and Cutting Lubricant on 8-Spindle Conomatic

For exacting metal-cutting requirements, the Sun Oil Company perfected "Sunicut," a clear, free-flowing, straight, cutting lubricant, produced by an exclusive process.

Here is a typical example of the fast, accurate work which is being done in hundreds of shops with Sunicut:

Machine: Cone Automatic Machine Co. 8-spindle Conomatic
Operation: Turning (2⅛" Form-Tool), drilling and reaming (3⅛" depth), knurling
Material: 1335 Hot rolled bar stock
Spindle Speed: 275 R.P.M.
Cycle: 33 seconds
Feed: (drilling and reaming) .007" per revolution
Machine lubricant: Sunicut
Cutting lubricant: Sunicut

Sunicut has high lubricating value and is an excellent dispenser of heat. It makes possible heavy cuts at high speed while maintaining accuracy and finish. Call the Sun Cutting Oil Engineer in your territory for full information, or write...

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THE LUFKIN RULE CO., SAGINAW, MICHIGAN, New York City

tool taking wheels up to ⅞ in. in diameter and has a speed of 50,000 rpm. Collet size is ⅛ in., weight 12 oz., and length 6¾ in.

The Model TT is also a turbine-type tool taking wheels up to 1¼ in. in diameter. Speed of this grinder is 30,000 rpm. Collet size is 15/64 in., weight 2 lb., and overall length 9 in.

Operating on the vane-type principle, the Model PVT takes wheels up to 2½ in. in diameter. Standard speed is 10,000 rpm., with a collet size of 16/64 in., weight 2 lb., 4 oz., and overall length of 9 in.

The speed is regulated by an exhaust-type governor which not only holds the predetermined rate of speed, but also assures an insignificant drop off in speed when the grinders are put to work.

Portable Instrument Compares Surfaces with Known Standard

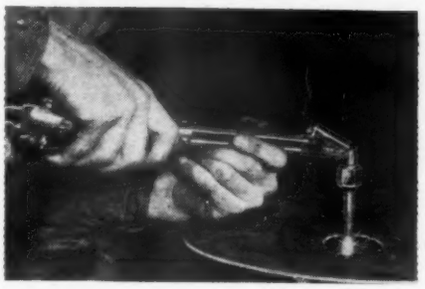
Although supplied with a stand, the Comparoscope can be removed and used directly against the work on the production line

An optical instrument to compare and evaluate surfaces against known or accepted standards is made by the Compar-Instrument Co., 16179 Hamilton Ave., Detroit 3, Mich. The Comparoscope is a dual microscope, equipped with a master-stage and a base with an adjustable stage, so that two surfaces can be viewed and compared. The instrument can be lifted from the base and used directly on the production line. It has its own illuminating source, a 6-volt lamp, current for which is supplied through a transformer.

The Comparoscope operates on the simple principle that light falling on a perfect surface at one angle is re-

flected in the other direction at the same angle. Such a surface, therefore, appears black under the Comparoscope since no light is reflected to the operator's eye. With rougher surfaces, the light is broken up and an increasing amount is reflected to the eye. In this way roughness is indicated by surface brightness and direct comparison can be made with the sample used as a standard.

Fatigue Reduced by Cut Torch With Balance and Light-Weight



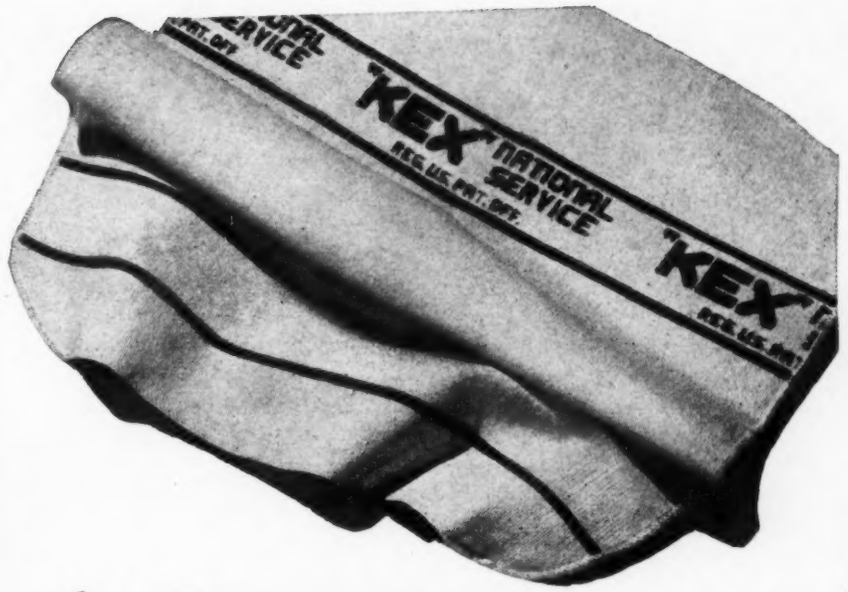
The Gasweld Featherweight cutting torch manufactured by the Wall Chemicals Div. of Liquid Carbonic Corp., 3100 South Kedzie Ave., Chicago 23, Ill., is designed for light metal cutting and occasional heavier cutting.

Weighing 2 lb. 2 oz., its light weight and balance are intended to step up production by cutting down operator fatigue. The torch is 16 in. from tip to butt of handle. The torch is available with either 80° or 90° forged head.

Powdered Metals for Welding; Unit Will Also Project Flux

A new method of welding, brazing, or surfacing with infinite compositions of powdered materials has been introduced by Powder Weld Co., 419 Kent Ave., Brooklyn, N. Y. The equipment consists of a torch, made in the general outlines of an ordinary welding torch, with a special nozzle and 16 controls, many of them at the handle of the tool; a control box with air- and gas-pressure regulating valves; and a canister from which powdered materials are fed through the flame.

The operator is said to have precise control of the amount of flux to be used with the metal or alloy, of the amount of the mixture used, of the flame temperature and atmosphere, of the temperature of the material projected, and of the temperature of the work surface. Powder Weld is said to be suitable for hard facing, surfacing with plastics or synthetic enamels, brazing with pow-



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Unlike rags or waste, every square inch of a KEX Wiping Cloth is usable *wiping* surface—right out to the very edge. KEX Wiping Cloths absorb up to six times their weight in grease or oil. They have no buttons, hooks, hard seams, loose threads or any of the million-and-one things that make ordinary wiping materials so hazardous to use. KEX Wiping Cloths are soft, safe for delicate surfaces—yet tough enough for any job in the shop.

KEX Wiping Cloths are delivered as often as needed. They are fresh—chemically cleaned by a *special* high-heat process. You always have plenty of clean KEX Wiping Cloths on hand, in any of your plants no matter where located.

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Try the KEX Wiping Cloth system, today! There's nothing to buy—no expensive inventory—just a low monthly rental. And the very first month you should show decided savings on wiping costs.

For complete information, phone your local KEX representative—or write KEX National Service, 295 Fifth Avenue, New York 16, N. Y.

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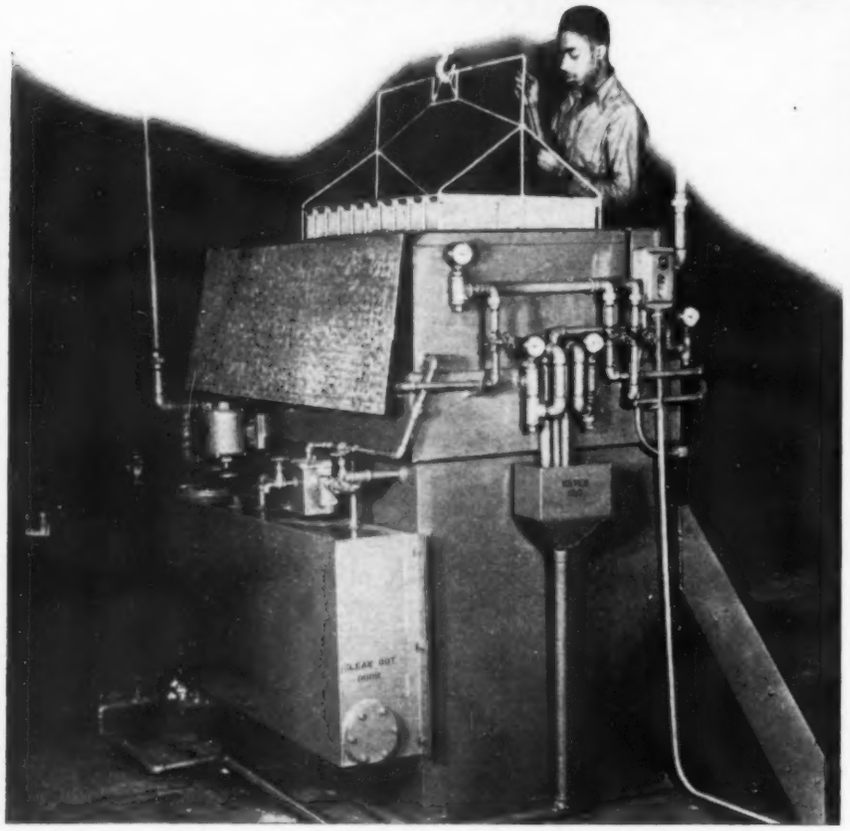
SMALL DEGREASERS FOR BIG JOBS



DETREX VS-800

Standard Detrex VS-800 solvent vapor degreasers—both steam- and gas-heated—are filling requirements in many shops where difficult cleaning operations are encountered, and where floor space is at a premium.

Available in many different sizes, the VS-800 has work clearances slightly less than the overall dimensions of the unit. Solvent vapors and a spray of clean solvent distillate effectively removes the oils, greases, waxes and insoluble soils encountered in metal processing. Caked-on dirt, particularly, is easily taken off by the jet of warm solvent. Work emerges clean and dry, ready for further processing.

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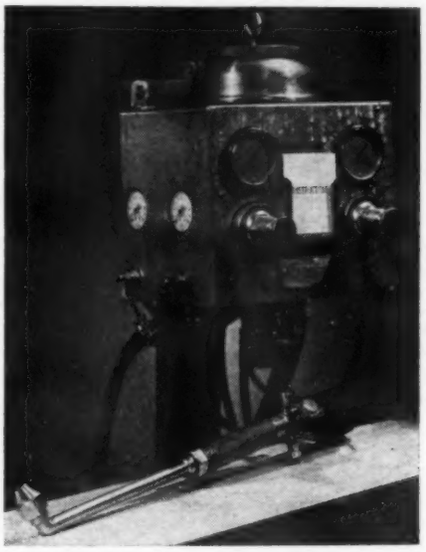
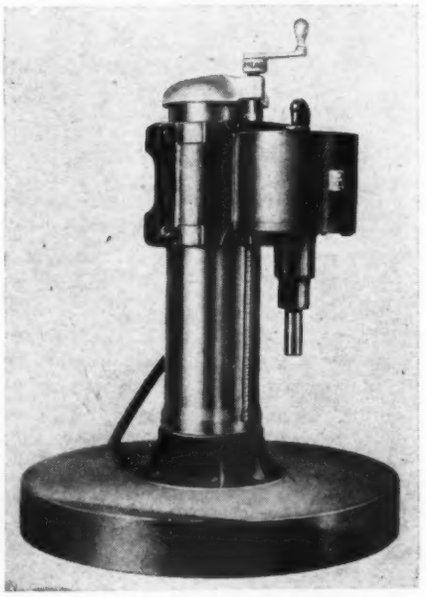
dered alloys, welding with powdered metals, rod welding with projected fluxes, controlled atmosphere welding, conventional torch and rod welding, metal spraying of all kinds.



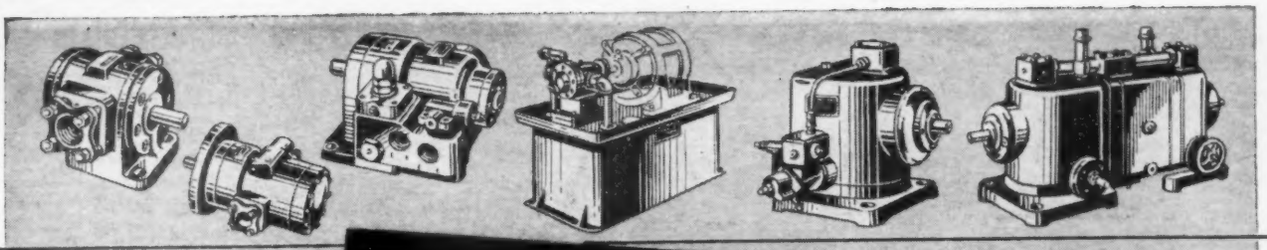
Compositions of powders or finely divided metals together with suitable fluxes are projected through the flame onto the work surface, eliminating use of separate rod or flux, in this Powder Weld unit

Several Fixtures Mounted at Once Possible with Mead Column Press



A number of fixtures may be mounted around the base of this column press and the ram swung over the desired fixture

Successive operations may be performed by simply swinging the ram over the desired fixture on an air-operated column press built by Mead Specialties Co., 4120 North Knox



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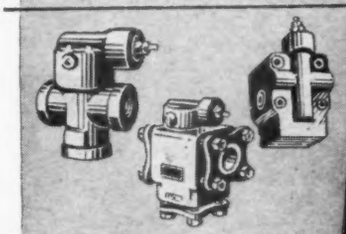

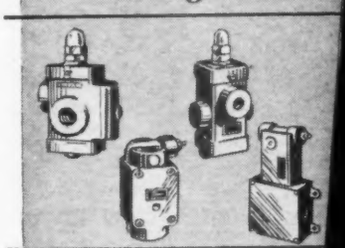

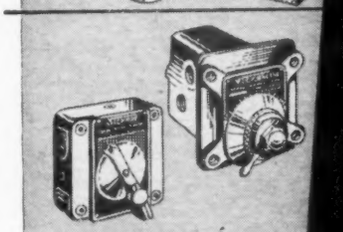

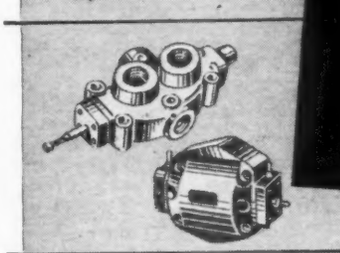

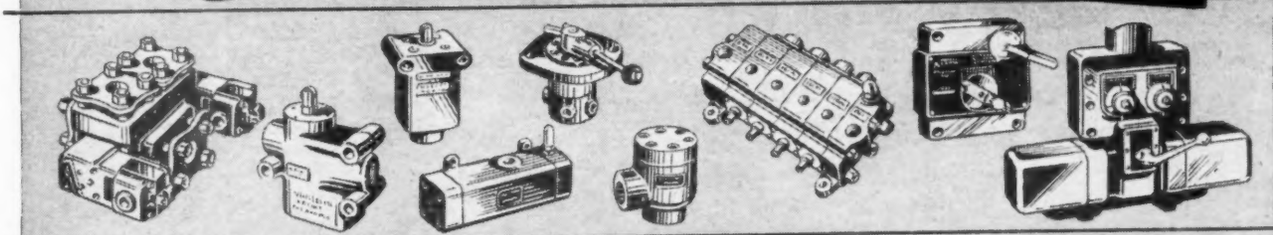

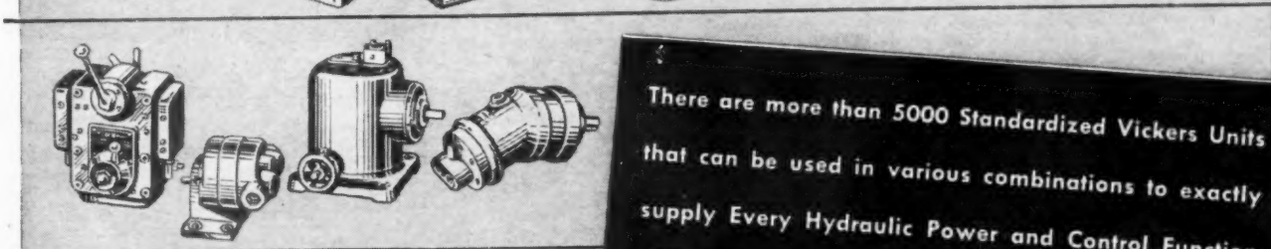

There are more than 5000 Standardized Vickers Units that can be used in various combinations to exactly supply Every Hydraulic Power and Control Function

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COMBINATION CIRCULAR CUTOFF *and* CHAMFERING TOOL

for Brown & Sharpe Automatic Screw Machines

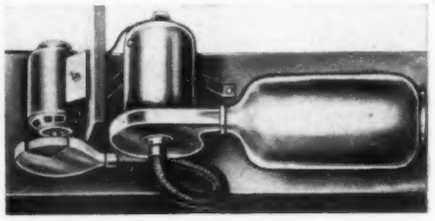
Rarely will it be necessary to purchase *special* cutoff and chamfering tools for use on Brown & Sharpe Automatic Screw Machines. Weldon now offers a large line of such tools which can be *ordered from stock.* The tools in this new Weldon line cover a wide range of sizes to meet chamfering requirements to practically all diameters. A choice of two cutoff angles is offered—15° for steel or 23° for brass. Orders promptly filled through our local distributor or direct from factory stock.

Write for Folder No. 575
with List Numbers and Prices

THE WELDON TOOL CO. Cleveland 4, Ohio
3000 WOODHILL ROAD

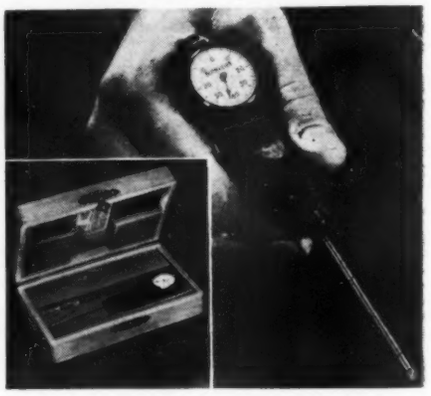
Ave., Chicago 41, Ill. This unit delivers a ram pressure of 3000 lb. on 110-lb. line pressure, is particularly useful for small to medium runs where it is desirable to leave fixtures permanently mounted to the base.

As many as a dozen small fixtures may be left permanently set up, ready for use when needed. In general, it is desirable that the fixtures be self-sufficient, requiring only the pressure of the plain ram to complete the operation. This eliminates the need for attaching dies, punches, and other tools to the ram for each new operation.



DUST COLLECTORS — This Model 27 Tornado is equipped with a 1/5 hp. motor. Suction produced is said to catch all suspended dust particles thrown off by the grinding wheel. These collectors are made in various sizes by Breuer Electric Mfg. Co., 5100 N. Ravenswood Ave., Chicago 40, Ill.

Extremely Small Holes Gaged With Federal Dial Indicator

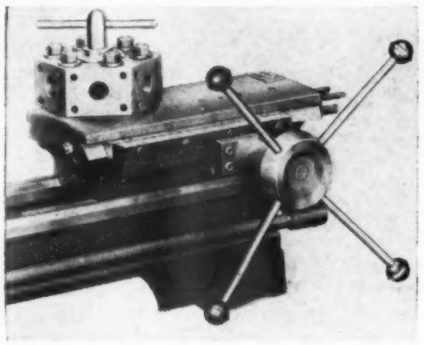


A dial indicator gage for extremely small holes is made by Federal Products Corp., 1144 Eddy St., Providence, R. I. This gage can be used on holes as small as 0.122 in. and up to 0.250 in. Holes can be handled to depth of 2¾ in. Variations within the range are obtained by the use of a set of 12 interchangeable gaging plugs.

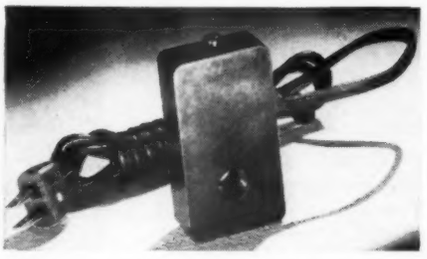
This is said to be the first time that holes of such small diameters have been gaged with an indicator-type gage. Designated the Model 1203 P-1, this gage is calibrated and set to reveal conditions up to plus or minus 0.004 in. Minimum graduation is 0.001 in. It is regularly furnished for use

as a single-purpose gage, but additional plug sizes can be adapted and calibrated by using a micrometer caliper.

SURFACE PLATES—With a working area 14 x 24 in. this surface plate made by the DoAll Co., 1301 Washington Ave. S., Minneapolis 4, Minn., is made of a specially alloyed close-grain iron. Underside of the overhang is machined so work or fixtures can be clamped to the plate. Edge is drilled and tapped on 2-in. centers to mount gages or fixtures.

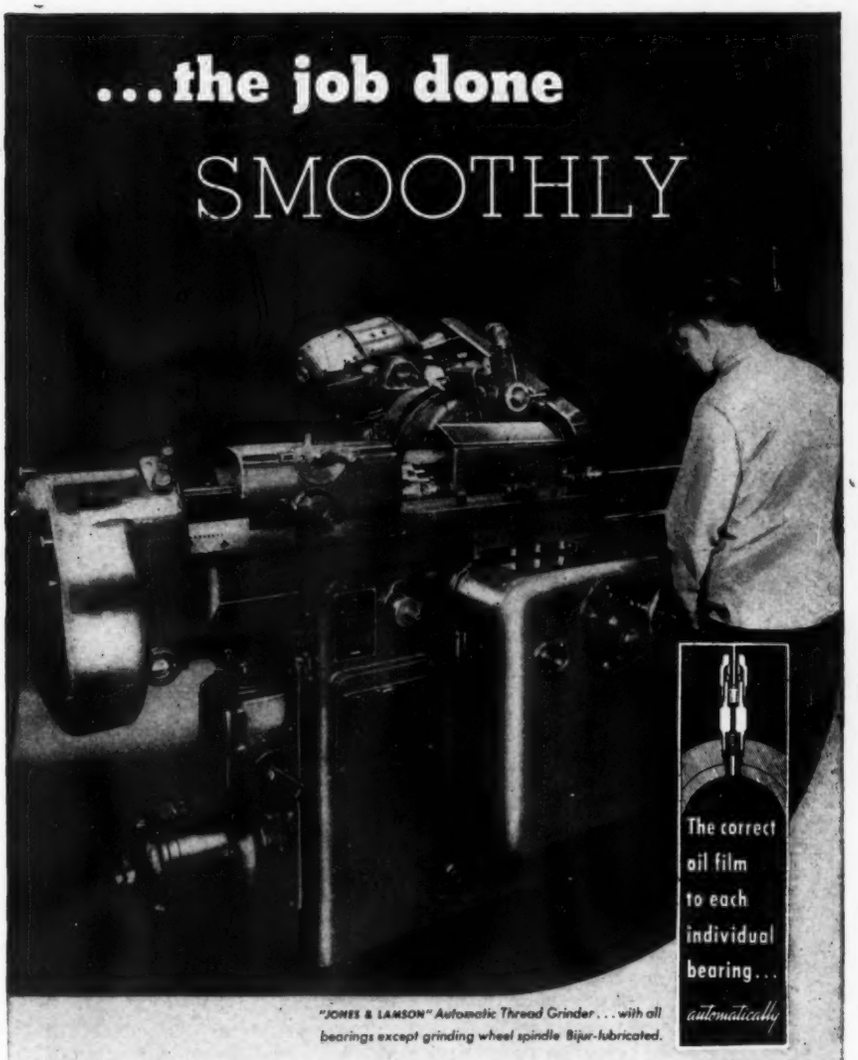


BED TURRET—This Hexturret uses double steel drive gears and double racks for equalizing the feed of the tool on the work. Double gibs of heavy-duty type are employed to maintain accuracy. Used on lathes up to 14-in. swing, this bed turret is made by Enco Mfg. Co., Chicago, Ill.



DEMAGNETIZER—Tools with a diameter of 7/16 in., or less, are demagnetized in this unit built by Grayhill, 1 N. Pulaski Rd., Chicago 24, Ill. Operating on 115 volts a.c., the unit can also be used to magnetize objects when desired.

...the job done
SMOOTHLY



"JONES & LAMSON" Automatic Thread Grinder . . . with all bearings except grinding wheel spindle Bijur-lubricated.

● No time is lost from productive work . . . a BIJUR-equipped machine oils itself, while running! Metered oil-feed—the correct oil-film needed by each individual bearing—is supplied automatically. The efficiency of operator and machine is raised . . . precision standards are held . . . maintenance is reduced to a minimum . . . production stepped up!

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Precision gears in quantity!

Our plant is equipped with all modern machine tools for the quantity production and prompt delivery of precision gears to customers' specifications.

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PERKINS MAKES: Helical Gears, Bevel Gears, Ratchets, Worm Gears, Spiral Gears, Ground Thread Worms.

PERKINS WORKS IN ALL MATERIALS: Cast Iron, Steel, Bronze, Brass, Aluminum, Stainless Steel, Cast Alloys, Monel Metal and Non-Metallic Compounds or Compositions.

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Precision, Custom-Cut GEARS

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ROUND TABLE DISCUSSION

SHOULD MACHINISTS BE LICENSED?

I have had some bitter experiences in the past three years while trying to obtain a job as a toolmaker. Employers have been stuck many times by persons who claimed to be toolmakers but were unqualified. As a result, employers are cautious and want satisfactory proof of a man's ability.

I have worked in shops alongside men who were supposed to be toolmakers and drew toolmakers' wages. They knew nothing about trigonometry, yet it is an essential part of the toolmakers' shop work. Such men have made it difficult for persons who have devoted much time and effort to improving their qualifications. A man cannot become a good machinist or toolmaker merely by serving an apprenticeship and learning how to run a lathe or a shaper. It requires a considerable amount of hard study in the mathematical and designing field and a considerable amount of research work.

The pride of being a good machinist or toolmaker is fading today. I served a three-year apprenticeship in 1930 and have spent all my spare time in the last three years on studying mathematical problems and practical applications. Yet I find that any person who can run a lathe or a shaper is considered just as good a machinist as the man who devotes much extra time to reach a higher standard.

I agree with Al of the Round Table that examinations and licenses would improve the lot of many competent machinists and toolmakers. Employers would be in a better position to hire qualified men. If a set of 40 or 50 questions pertaining to all types of shop problems—milling, lathe, grinding, shaper, layout and others —were made up, ratings could be issued. Applicants could be rated as first- and second-class machinists or toolmakers.

Those receiving lower ratings could improve their standing by extra study. It would be a fast system of weeding out the misfits and fakers. Results of the exam would indicate weaknesses to the applicant.

The difference between a toolmaker and a machinist has been debated many times. I can partly answer this by saying a good machinist needs to be a good precision worker and needs

good precision tools. A machinist, however, does not need as thorough a background as the toolmaker. A machinist can be skillful in operation of a lathe, mill, shaper and grinder, but he follows the drawings and if they are wrong he is not at fault. When a man can design his own jigs and fixtures, and lay out the work accurately, machine all the parts to precision tolerances and check his work to see that the part will perform its given job, then he is a toolmaker.

I would like to hear more about the licensing of machinists and toolmakers because the subject offers plenty of room for good argument.

Edward C. Jeram
Denver, Colo.

•

SHOULD A FOREMAN BE COST CONSCIOUS?

The outgrowth of a foreman's responsibility to his company is a pure and simple case of reduced costs. Every time he cements good relations between labor and management, factory costs drop automatically. They do not reflect themselves in reduced manufacturing time, but do show up in a smaller amount of rework costs and extra handling, caused by faulty workmanship.

Most toolrooms operate on the basis of estimated cost or bid price business. No shop can operate long or manufacture its own tools if the foreman does not exert some semblance of cost control. This responsibility can be developed easily by maintaining a constant check of actual against estimated shop time consumed on each job. The cost of maintaining this record will soon pay for itself in improved shop practice.

No foreman will attend many factory meetings where his departmental efficiency is decried without making an effort to "get the boss off his back."

A systematic check of the shop often turns up many conditions that had been considered normal. A correction of these can open many avenues of cost savings. Some of these may be: mislocation of some machinery or supply crib; requirements of a special tool crib; procurement of additional or newer equipment; need for making some makeshift setup permanent; removal of some mental hazard to workmen; addition of some safety feature to a machine, jig or fixture; need for more preparation of the stock before it is given to the operator; or the need for compiling components of the bill of material rather than have the workman spend

MEASURING in MILLIONTHS

. . . for three generations

IN SWEDEN, before the turn of the century, Hjalmar Ellstrom, father of Elmer Ellstrom, the present head of the Dearborn Gage Company, built the first known gage blocks to accuracies of millionths of an inch.

That same Ellstrom was the production genius of the first company ever to sell master gage blocks commercially.

Today, his son and grandsons are carrying on in his footsteps by making gage blocks for industry throughout the world. In fact, they were the only ones to make a major improvement on Hjalmar Ellstrom's original gage block by successfully chromium plating the gaging surfaces of their blocks to increase their wearing qualities.

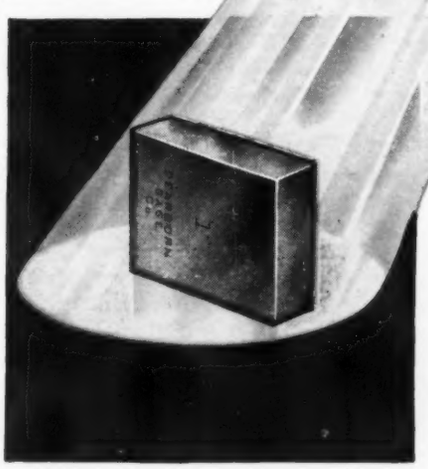
Yes, in three generations, craftsmanship in millionths of an inch has become a tradition with the Ellstrom family. This has prompted the writing of a booklet entitled, "The Saga of Ellstrom". It tells the complete story of the development of the gage block. Your copy will be sent you upon request, just write the Dearborn Gage Company, 22038 Beech Street, Dearborn, Michigan.

HJALMAR ELLSTROM

ELMER ELLSTROM

OLOF ELLSTROM

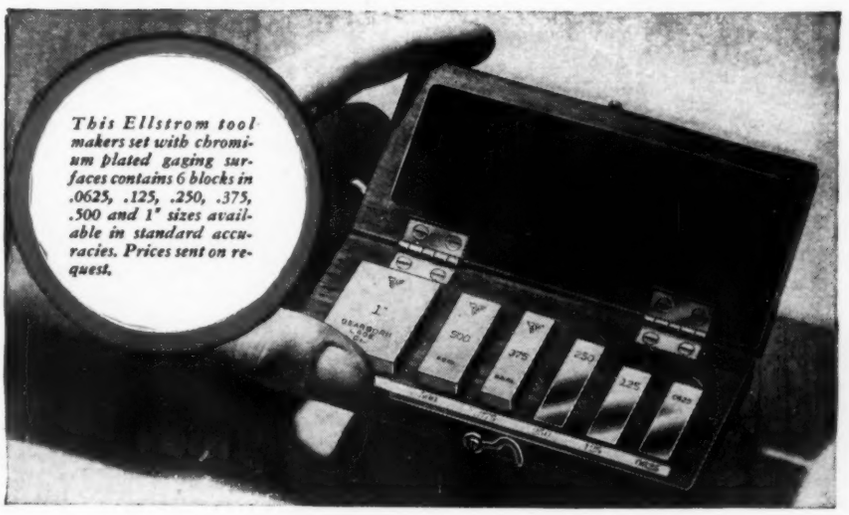
Ellstrom
3 GENERATIONS of GAGE MAKERS



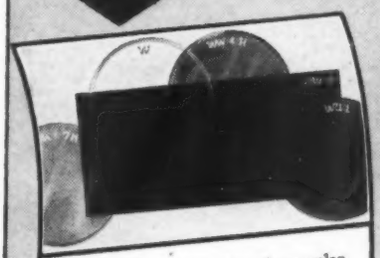
ELMER ELLSTROM II

RALPH ELLSTROM

DEARBORN GAGE CO.
22038 Beech St. Dearborn, Michigan
Originators of Chromium Plated Gage Blocks

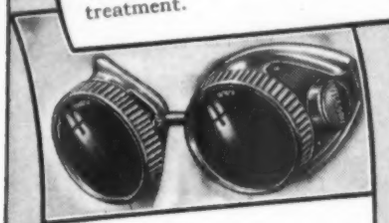

This Ellstrom tool makers set with chromium plated gaging surfaces contains 6 blocks in .0625, .125, .250, .375, .500 and 1" sizes available in standard accuracies. Prices sent on request.

Get This Assurance of Reliable Eye Protection



These Willson trademarks represent 75 years of pioneering. They identify fine safety glass that protects workers from eye injuries. Keeps them on the job. Prevents production time-outs.

To safeguard eyes from flying particles, Willson developed Super-Tough* glass. Thoroughly tested for impact resistance. Example: Polariscope test checks uniformity of heat treatment.



Willson-Weld* glass is green in color. Filters out dangerous infra-red and ultra-violet rays. Reduces intensity of visible light. Yet permits objects to be seen in their natural colors.

For help with your eye-protection problems, get in touch with your Willson distributor or write for further information.

*T. M. Reg. U. S. Pat. Off.

GOGGLES • RESPIRATORS • GAS MASKS • HELMETS

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Established 1870

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his valuable time doing such tasks. If any of these problems are plaguing a foreman, prompt attention to them will definitely curtail costs and improve efficiency.

Every company should realize the importance of having key personnel fully aware of the fundamentals surrounding its cost system, and the basis for arriving at estimates used to set shop schedules. This knowledge will not only aid the foreman in making improvements in his departmental operations, but will make his job easier when he is called upon to discuss wage rates or factory procedure with one of his employees.

A. W. Levenhagen
Cuyahoga Falls, O.

•

With the return to peacetime production and competition, as opposed to wartime cost plus and production-at-any-price methods, the importance of cost control in the life of any business again assumes its rightful place. The ability to recognize this factor and apply the best methods possible to keep his departmental costs at a minimum once again becomes of paramount interest to the progressive foreman.

More especially is this true in the small shop where the foreman is very often the estimator, setup man, and general expediter. Here again, costs have to be scrutinized with an eagle eye if the business is to survive—let alone make money. For instance, most small shops operate on a contract basis, making an estimate from a customer's blueprint. With several shops submitting quotations on a job, the low bidder—all other things being equal—is likely to get the work. Once obtained, it becomes the duty of the shop foreman to produce the part or parts at or under the quoted figure. Obviously, the cost-conscious foreman is the man most likely to succeed when the postwar chips are down.

Robert S. Alexander
West Warwick, R. I.

•

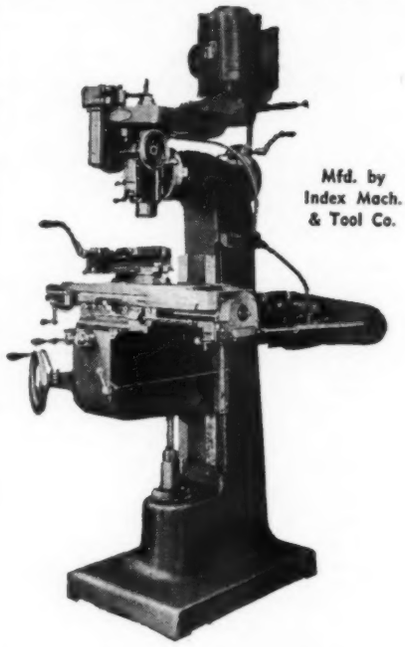
WINDOWLESS SHOPS?

General opinion in many circles is that windowless shops are definitely not a fad, but the coming thing. They may even become a necessity in the near future when the efforts of every worker will be required to produce the articles that the future has in store for us.

The objection of air-conditioning as being the cause of colds can be answered by explaining that colds are also caught by employees work-

INDEX MILLS

will help you on your tool, die and production work. In addition to micrometer dials on screws, verniers are standard equipment for cross and longitudinal locating. If finer precision is desired, rods and indicators are available. These in conjunction with power feed to a precision ball bearing spindle make a very versatile machine for milling, drilling and boring. ***Literature promptly mailed on request.***



Mfd. by Index Mach. & Tool Co.

12" Tool Room Rotary Table

A quality tool for precision work in the tool room or production line, incorporating such features as ball bearings—hardened and ground worm—quick acting throw-out for free hand turning—single movement table lock that does not cramp table out of alignment—compound trough. 12" size only.

For use on Index Mills or any other machine that will accommodate a 12" table.

BLANK and BUXTON MACHINERY

3100 E. MICHIGAN AVE.
JACKSON, MICH.

ing in front of an open window. If air ducts are arranged so they do not blow directly on the worker, the danger of colds from this source can be eliminated.

The advantages of air-conditioning to the plant owner result in an increase of accuracy as well as an increase in the work produced since no outside happenings that may attract the worker's eye can interrupt his train of thoughts. Much of the so-called "Spring Fever" which often happens when the sun shines brightly through the windows can also be eliminated. The workers can dress more suitably to the temperature in the shop and work without discomfort.

The psychological effect on the workers would be negligible if the project and advantages are clearly explained. Certainly there will be those who complain—but they would do so under any conditions and usually do.

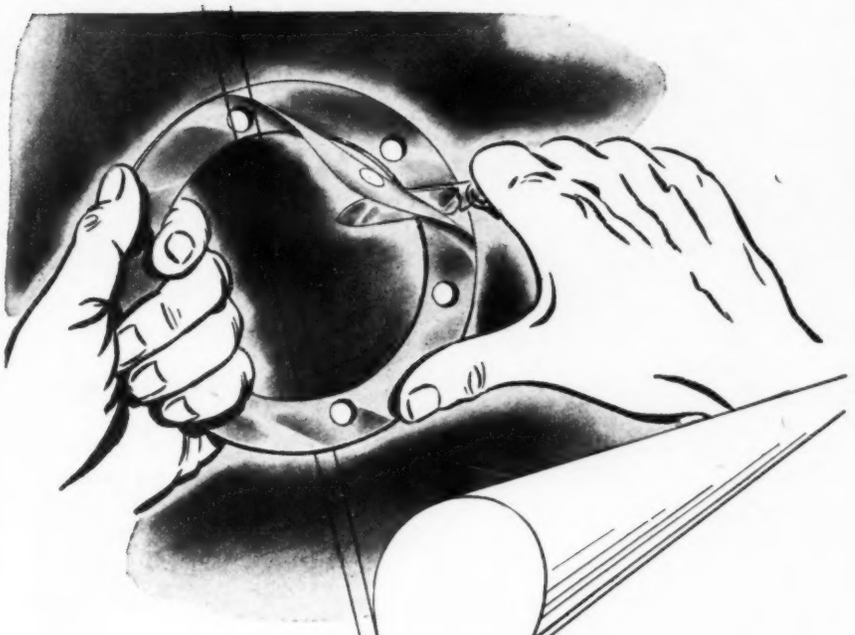
Robert T. Knotek
Cleveland, Ohio

NEW BOOKS

ESTABLISHING AND OPERATING A METAL WORKING SHOP—*Industrial Series No. 16, originally prepared as an Education Manual for the War Department, by the Bureau of Foreign and Domestic Commerce, and now authorized for general distribution. Available from the Supt. of Documents, U. S. Govt. Printing Office, Washington 25, D. C. or at Field Offices, U. S. Dept. of Commerce. 202 pages, 6 x 9 in. Price $0.35.*

Twenty chapters and a check list comprise this paper-covered booklet, which provides an over-all summary of the problems which must be met. General chapters cover such subjects as location, investment, organization, building type and layout, business sources, costing, credits, collections, records, financing, purchasing, safety, expansion. Types of metalworking plants discussed individually include machine, welding, sheet-metal, ornamental-metal and mobile.

This is a worthwhile addition to the library of any small-shop owner, no matter how long his business has bee nestablished or how successful it is. Pointers gathered from metalworking men all over the country are set down without fuss or feathers, providing a quick reference source for general principles in any department of the business.



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THE SOLID SHIM THAT peels FOR ADJUSTMENT

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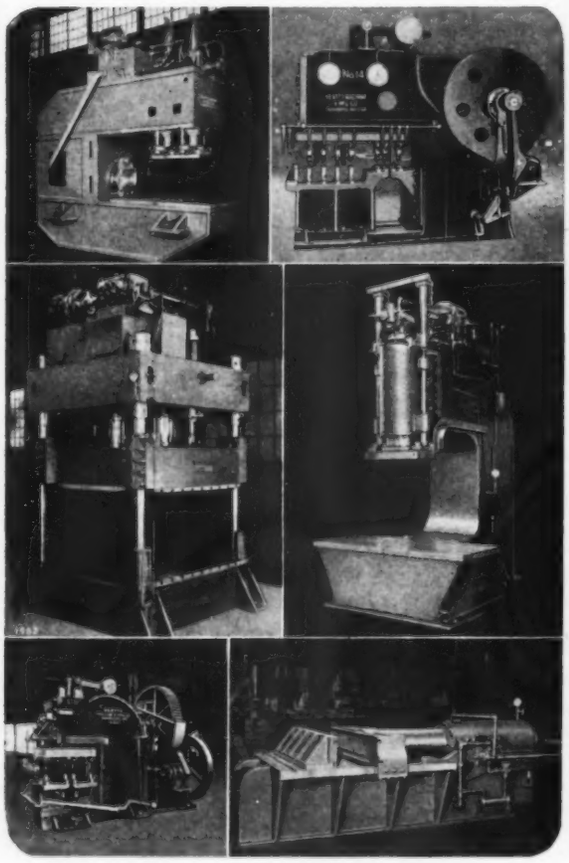
THROUGHOUT the heavy metal working industry BEATTY designed equipment is bringing greater speed, greater accuracy and lower costs to all basic operations. It's the engineering *behind* a BEATTY machine that puts that machine out in *front*. Let us know *your* problem.



BENDING
BLANKING
BULLDOZING
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EXTRUDING
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FORMING
JOGGLING
PUNCHING Structural Plate
SHEARING
SHAPING
STRAIGHTENING
PERFORATING

BEATTY MACHINE AND MFG. COMPANY
HAMMOND, INDIANA

PAY DAY. *By Ray Millholland. 240 pages. Published by William Morrow & Co., Inc., 425 Fourth Ave., New York, 16, N. Y. Price $2.50.*

This easy-to-read work provides a thorough analysis of the pros and cons of labor-management relations, with many provocative observations by the writer, a former apprentice machinist, machine-shop foreman, and a factory owner. Service with the War Production Board on industrial relations and the fact that he is an experienced engineer lend further weight to the author's balanced criticism of the errors of both labor and management since the beginning of the American labor movement.

His discussion of the guaranteed annual wage is a most devastating criticism of this growing demand on the part of labor. The author speculates on the establishment of the guaranteed annual wage throughout industry and states "if anything like this ever happens . . . the Patent Office will have to lock its doors and toss the key into the river lest some rascally inventor throw a nicely balanced economy out of gear." The book further picks this idea apart, and concludes that only through regimentation could a widespread guaranteed annual wage work.

Major topics covered include piece work, plant rules and discipline, closed or open shop, union leadership, suggestions, disputes and grievances, and women in industry. These and other subjects are picked apart in a provocative manner unusual for a labor-industry book.

•

TRENDS IN COLLECTIVE BARGAINING—*By S. T. Williamson and Herbert Harris. 254 pages. Published by The Twentieth Century Fund, 330 West 42nd St., New York, 18, N. Y. Price $2.*

THE AUTHORS COVER the major aspects of the various labor trends in this country in a brief and conveniently indexed manner, and this work is supplemented by the report and recommendations of The Twentieth Century Fund's Labor Committee. Highlights of historical developments affecting wages, bargaining agencies for workers and employers, union recognition, collective agreements, and other important phases of the labor movement are set forth in a completely unbiased fashion. The committee's recommendations on such matters as industry-wide bargaining, bureaucracy in unions, and union responsibility are particularly significant. On union responsibility, the com-

mittee states in part: "The top-flight leadership of labor could do nothing better than to start to revalue some of its existing values in the search for a new conscientiousness that would not be entirely divorced from overtones of a new conscience." These proposals are significant in view of the balanced make-up of the committee, which included William H. Davis, former chairman of the National War Labor Board, two representatives of industry, two union officials, two college professors, and the editor of *Collier's Weekly*.

Rules For *NOT BEING* A First-Class Machinist

BY WILLIAM E. PHILLIPS

After observing the general carelessness about putting tools back in the average small machine shop, the writer typed the following rules:

1.—NEVER PUT ANYTHING BACK WHERE YOU GET IT. (This makes it too easy for the other fellow to find it. Make him hunt for it—then he'll do the same for you. That way you both lose ten times as much time as it would take to put it back in the first place.)

2.—NEVER HAVE A PLACE FOR ANYTHING.
(In this way no one knows where anything belongs. Some kind souls make a home for these homeless tools by taking them to their own home. All this adds to the confusion and helps increase inefficiency.)

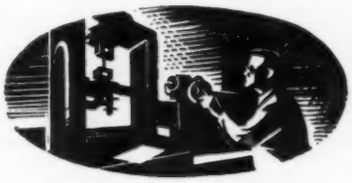
3.—ALWAYS CLAIM YOU HAVEN'T TIME TO PUT ANYTHING BACK IN PLACE EVEN IF IT HAD A PLACE. (This is the alibi of the little boss; and fools only the unthinking. The really efficient boss knows he must keep things where he can find them if he is to conserve his time. Seeing this, those under him will follow his good example.)

4.—LET THIS BE YOUR MOTTO: "NO PLACE FOR ANYTHING AND NOTHING IN ITS PLACE."

(This makes a jolly mess of everything and causes many merry mixups which in the end cost much more than an orderly tool-control or any orderly way of running a shop.)

Every alloy bar in Ryerson stock is identified with heat symbols and color marks.

Jominy tests of each heat furnish hardenability data for Ryerson Alloy Report.



Physicals interpreted from hardness readings of Jominy samples are checked by tensile test.

Final inspection assures accurate shipment of steel exactly as ordered from Ryerson.

Get this Proof of Performance

in Alloy Steel from Stock

A positive performance record is yours with each heat of alloy steel from Ryerson, because a Ryerson Alloy Report accompanies every shipment. This Report contains charted results of four Jominy hardenability tests plus the obtainable physical properties for various sized rounds of your particular heat of steel.

Chemical analysis and recommended working temperatures are also included and each Report is keyed with the heat identification number of the steel to which it refers.

In this way you have assurance that your steel meets laboratory-proved standards of performance and it can effect important savings for you. So many companies gain better heat treating results through the use of Ryerson Alloy Reports that we believe this service may also help you.

Whether you specify, buy or work on alloy steel you will find real advantage in Ryerson alloy service. Get in touch with the plant nearest you.

Joseph T. Ryerson & Son, Inc. Steel-Service Plants: Chicago, Milwaukee, Detroit, St. Louis, Cincinnati, Cleveland, Pittsburgh, Philadelphia, Buffalo, New York, Boston.

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Hydrogen-reduced tungsten metal powder is manufactured under the most rigid control to particle sizes of 5 microns, max., for precision carbide uses, or in wider ranges to 25 microns, max., where larger size is preferred. A purity of 99.9% tungsten content is maintained.

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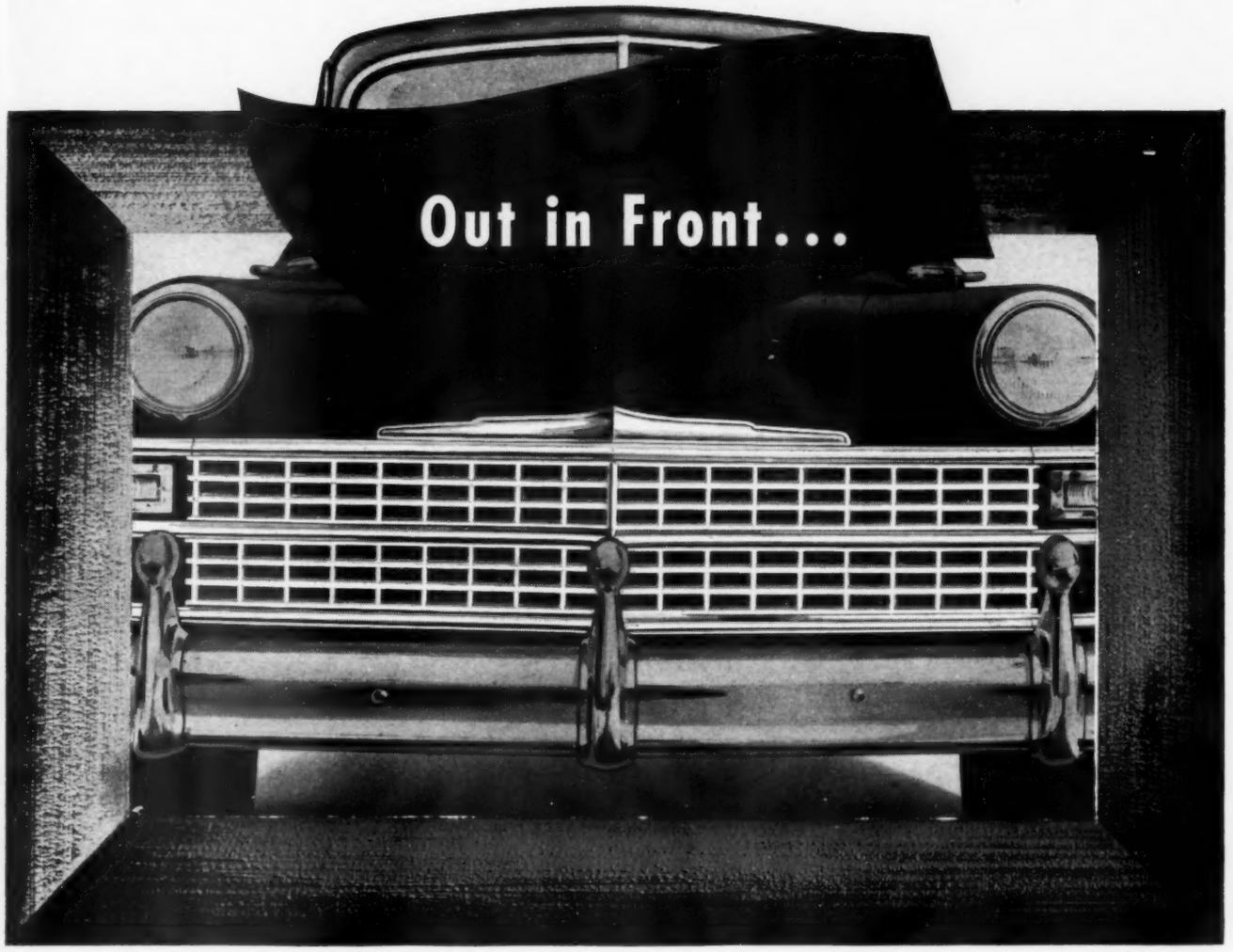

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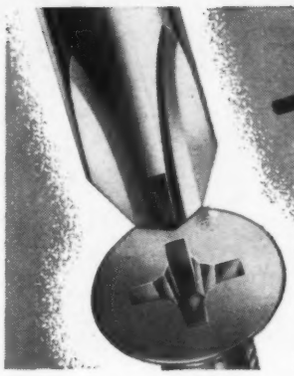
Send to Dept. MA for a copy of the new Dzus catalog. More and more manufacturers in all fields of industry are finding that Dzus spiral cam fasteners squarely meet all the requirements for a dependable fastener.

*** The word Dzus is the registered trade mark of the Dzus Fastener Co., Inc.**



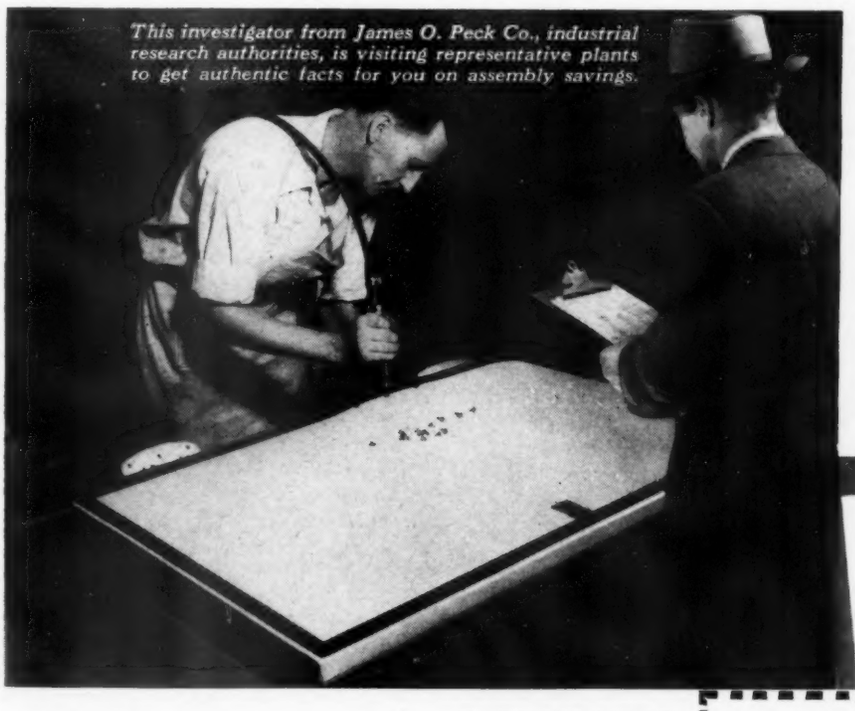
INDEPENDENT INVESTIGATOR'S STUDY SHOWS

Phillips Screws give each assembler a needed "extra hand"... end costly driver skids at SERVEL

"WE couldn't possibly use slotted screws in these door panels," the chief cabinet engineer at Servel, Inc. told the investigator. "We know, from actual tests. In many places it would be impossible to guide a slotted screw with the driver except at a snail's pace, and our driver skid damage would be terrific."

TO GET THE COMPLETE FACTS on how this leading refrigerator manufacturer enlists the many advantages of Phillips Screws, the investigator asked the same questions you would ask – learned how they make big savings day after day – the kind of savings *you* can't afford to miss with today's squeeze on profits.

THIS REPORT, with others now ready, and more to come – comprise a practical manual of modern assembly methods, never-before-printed information, inside facts you'd pay good money to get, and you can have them now, FREE!



This investigator from James O. Peck Co., industrial research authorities, is visiting representative plants to get authentic facts for you on assembly savings.

HIGHLIGHTS FROM THE SERVEL REPORT

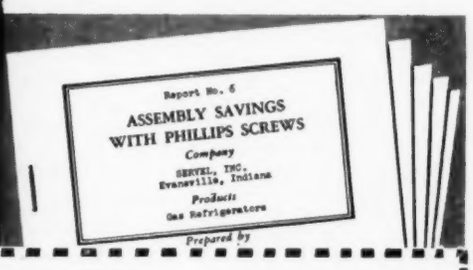
"AN ASSEMBLER WOULD NEED THREE HANDS to drive slotted screws under the rubber gasket in fastening inner door panels and even then, driver skid damage would be prohibitive. The Phillips driver is self-centering – makes it easy to guide the screw with one hand.

"IT COSTS MONEY to replace door panels punctured by skidding drivers, figuring the cost of a new panel, and time for taking out and replacing up to 43 screws. Slips are no problem with Phillips Screws. This advantage alone saves *plenty* in our big production.

"WE RAN A TEST six years ago on door assembly to prove that Phillips Screws cost much less to use than slotted. It was so convincing, no one ever suggested using slotted screws again in this application."

GET THESE REPORTS . . . READ THE COMPLETE FACTS . . . LEARN HOW YOU, TOO, CAN CUT ASSEMBLY COSTS!

All types of products are covered – metal, plastic, wood. The coupon will bring the reports ready now and the rest as they are issued. Fill it in and mail it, TODAY!



PHILLIPS Recessed Head SCREWS

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Atlantic Screw Works
Atlas Bolt & Screw Co.
Central Screw Co.
Chandler Products Corp.
Continental Screw Co.
Corbin Screw Div. of American Hdwe. Corp.
The H. M. Harper Co.
International Screw Co.
Lamson & Sessions Co.

26 SOURCES

Manufacturers Screw Products
Milford Rivet and Machine Co.
National Lock Co.
National Screw & Mfg.Co.
New England Screw Co.
Parker-Kalon Corporation
Pawtucket Screw Co.
Pheoll Manufacturing Co.
Reading Screw Co.
Russell Burdsall & Ward Bolt & Nut Co.
Scovill Manufacturing Co.
Shakeproof Inc.
The Southington Hardware Mfg. Co
The Steel Company of Canada, Ltd.
Sterling Bolt Co.
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Compelled to store $2,000,000 worth of boiler tubing outdoors — because of the wartime shortage of building material — this large manufacturer of marine boilers for our naval and merchant ships chose Tectyl 506 to save the huge stock from rust.

At times the storage yards were covered so deeply with snow that it was difficult to locate the tubing. But in spite of this extreme exposure, Tectyl gave unfailing protection.

Now returned to peacetime production, this company continues to specify Tectyl for the prevention of rust and corrosion.

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- Tectyl is not a paint; it leaves a thin, transparent film that keeps the metal in plain sight. Tectyl need not be removed for inspection.
- Tectyl is easy to apply — brush on, flush on, dip, or spray.
- Tectyl is easy to remove with kerosene or any ordinary hydrocarbon or naphtha compound. Tectyl saves time and labor.
- Tectyl is economical — a little Tectyl protects a lot of metal — Tectyl provides *low-cost-per-square-foot protection!*
- Tectyl is made in many specialized types; there's a Tectyl solution for every rust problem.

Phone, write or wire for Tectyl bulletin and specific recommendations for your needs. Please describe metals and types of exposure encountered.

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—practical information on grinding machines and abrasive wheels, showing what they do, how to operate them, and how to make best use of them on various types of work

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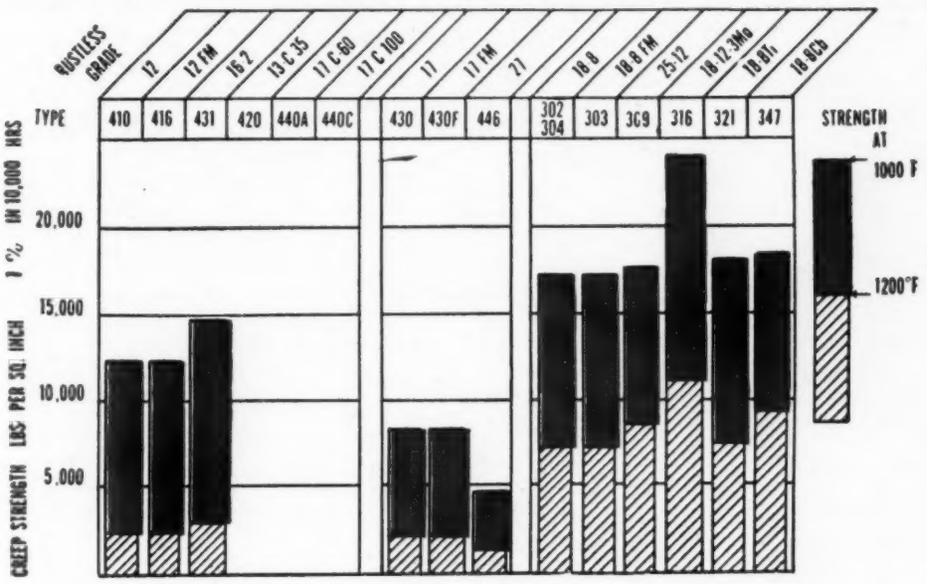
RUSTLESS DATA SHEET NO. 3

Corrosion Resistance Plus Strength at High Temperatures

One of the Many Combinations of Properties Offered by Stainless Steels



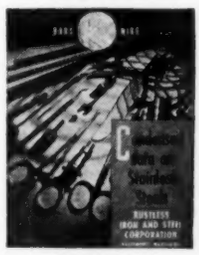
PERHAPS a better name for "stainless steels" would be "corrosion and *heat*-resisting steels." Actually, engineers figure one of the most valuable properties of these alloys is their ability to retain unusual strength and resist deformation at temperatures far beyond the softening points of most metals. Couple this with the ability of stainless steels to withstand the withering effect of greatly accelerated corrosion and scaling conditions, and you have the reasons for its extensive use in furnaces, petroleum cracking stills and accessory equipment, high temperature chemical processes, turbine blading, spark plug electrodes, internal combustion engine exhaust valves, glass molds, turbo-superchargers and aircraft engine exhaust manifolds and stacks.

There are many ways to measure strength at high temperatures: (1) "Creep" tests which measure the maximum load a material will carry for long periods of time without "creeping" or stretching more than some specified small amount; (2) Stress-Rupture tests, which measure the load carrying ability at high temperature; (3) Tensile tests, wherein the material is pulled apart in a relatively short time after reaching high temperatures; (4) Hot-Hardness tests useful in connection with exhaust valve materials.

A brief review of the above chart indicates that for products involving long exposure to temperatures exceeding 1200°F., the chromium-nickel or austenitic grades are best when heavy loads are to be carried. Note that outstanding in this group is Rustless 18-12-3 Mo, Type 316, containing molybdenum. This is the grade widely used for its excellent resistance to hot corrosive gases. When stresses are low, Rustless 27, Type 446, is still a candidate for selection because of its good resistance to oxidation up to 2000°F. The chromium-hardenable group on the left are subject to rapid softening over 1000°F. because they temper rapidly when this temperature is exceeded. Up to that point they are widely used for valve trim as they faithfully retain their hardness and erosion resistance. It should also be noted that a modified Type 410 is the outstanding material for steam turbine blading.

Of course, there is more to this subject than covered here. When you want to have it—just call Rustless. Write or wire—there is no obligation.

We have a vast amount of stainless steel information applicable to the solution of high-temperature problems. Write us the details of your specific case or cases, and the Rustless engineers will gladly cooperate with you, both in selection and fabrication. Or send for helpful literature; for example, "Condensed Data on Stainless Steels," which will be sent on request.



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21 WELDING SERVICE—Graver Tank & Mfg. Co., East Chicago, Ind. 18-page booklet describes place of weldments in industry and illustrates application of welding in fabrication of equipment such as machine bases, gear cases and large gears.

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24 VALVES—Cochrane Corp., Philadelphia, Pa. 28-page catalog 4150 contains valuable discussion of relief valves, advantages, engineering data, adjustments, installation and operation. Tables and charts cover steam consumption, sizing and other data.

25 PUMPS—Gray-Mills Co., Evanston, Ill. 6-page form No. HE-5656-5M-11-45 presents line of pumps for coolant systems for machine tools, lubricant pumps for presses and cleaning equipment for removing oil, grease and dirt from parts and tools.

26 FLOOR PLATE—Alan Wood Steel Co., Conshohocken, Pa. 16-page folder 25M-12-45 furnishes data on rolled steel floor plate for factory use. Variety of patterns are shown and advantages of each are given.

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PARTS AND MATERIALS

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32 FASTENERS—Simmons Fastener Corp., Albany, N. Y. 28-page catalog No. 845 covers design engineering data, installation instructions, applications and advantages of quick-lock fasteners of stud and screw types, spring lock fasteners and safety nuts.

33 HYDRAULIC CYLINDERS—Blank & Buxton Mach. Co., Jackson, Mich. 12-page bulletin "Corwin Cylinders" illustrates operating features and construction, lists different styles and gives complete specifications for each style.

34 LUBRICATORS AND FILTERS—C. A. Norgren Co., Denver Colo. 24-page catalog No. 400D discusses lubrication of metalworking machines and application of air line lubricators, filters and regulators, reducing valves and miscellaneous equipment as air vents, hose couplings and stems.

35 LOCKING DEVICES—P. & F. Corbin Div., American Hardware Corp., New Britain, Conn. 32-page catalog K396, 6th Ed., covers locking, catching and swinging devices for metal application. General details and specifications given on each item.

36 SLIDE CHART—Carpenter Steel Co., Reading, Pa. Slide Chart offered to simplify calculation of velocity flow and capacities of heat exchangers. Contains data on tube sizes, pressure table, weight table and information and specifications on stainless steel tubing.

37 MOTORS—Crocker-Wheeler Electric Div. of Joshua Hendy Iron Works, Ampere, N. J. Three bulletins SL-300-2, SL-300-1 and SP-1A illustrate Sealedpower, protected, explosion-proof and splash-proof squirrel cage and dc. motors and give specifications and prices.

38 FILTERS—Briggs Filtration Co., Bethesda, Md. Two 12-page bulletins SM-6-46 and SM-8-46 cover coolant and hydraulic oil filters. Types of coolants, use in machining and proper filters are discussed. Wealth of engineering data is given on hydraulic systems.

39 LUBRICANTS—Fiske Brothers Refining Co., Newark, N. J. 28-page service handbook discusses lubrication and special advantages and applications of Lubriplate lubricants of fluid and grease types. Recommendations given for specific problems.

40 MICROCASTINGS—Austenal Laboratories, Inc., New York, N. Y. 8-page bulletin "Microcast Process" discusses its development and industrial advantages. Shows variety of parts, impeller wheel, nozzle diaphragm, etc., that can be precision cast with wax patterns.

41 FORGING DATA BOOK—Steel Improvement & Forge Co., Cleveland, Ohio. 36-page data book "The Improvement of Metals by Forgings" covers in detail forging design, process operations, metallurgy, defects, machining, inspection and applications of commercial forging metals.

42 FLUID HANDLING EQUIPMENT—J. A. Zurn Mfg Co., Erie, Pa. 12-page catalog 45 illustrates line of strainers, control boxes, check valves, vents, interceptors and drains. Describes applications and installations of different types of equipment.

43 STEEL—United States Steel Corp., Pittsburgh, Pa. 16-page booklet "Corrosion of Steels" offers a concise explanation of theory and comparison of corrosion in copper, plain carbon and low-alloy steels. Chart shows influence of copper and time-corrosion curves of different steels. Discusses non-metalic coatings as corrosion preventatives.

44 BELLOWS—Chicago Metal Hose Corp., Maywood, Ill. 12-page bulletin covering stainless steel bellows contains cross-section views and data on use of bellows as equalizers, compensators, expansion joints and other applications.

45 QUALITY CONTROL—Federal Products Corp., Providence, R. I. Second edition of "Dimensional Quality Control Primer" presents excellent, simplified treatment of quality control methods. Average, range, etc. explained with working examples.

46 DRAWING COMPOUNDS—E. F. Houghton & Co., Philadelphia, Pa. 4-page bulletin "Drawing Compounds" emphasizes need for drawing compounds of proper type. Six compounds are described as to characteristics and use.

47 CIRCUIT BREAKERS — Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa. 20-page booklet B-3687 on type AB "De-ion" circuit breaker gives information on ratings and dimensions. Suggests arrangements for protection of circuits and explains trip-release actions.

48 CLEANING EQUIPMENT—Howard Engineering & Mfg. Co., Cincinnati, Ohio. 48-page book contains detailed information on design and application of metal cleaning and finishing machines. Includes cleaning machines, washers, dryers and other cleaners.

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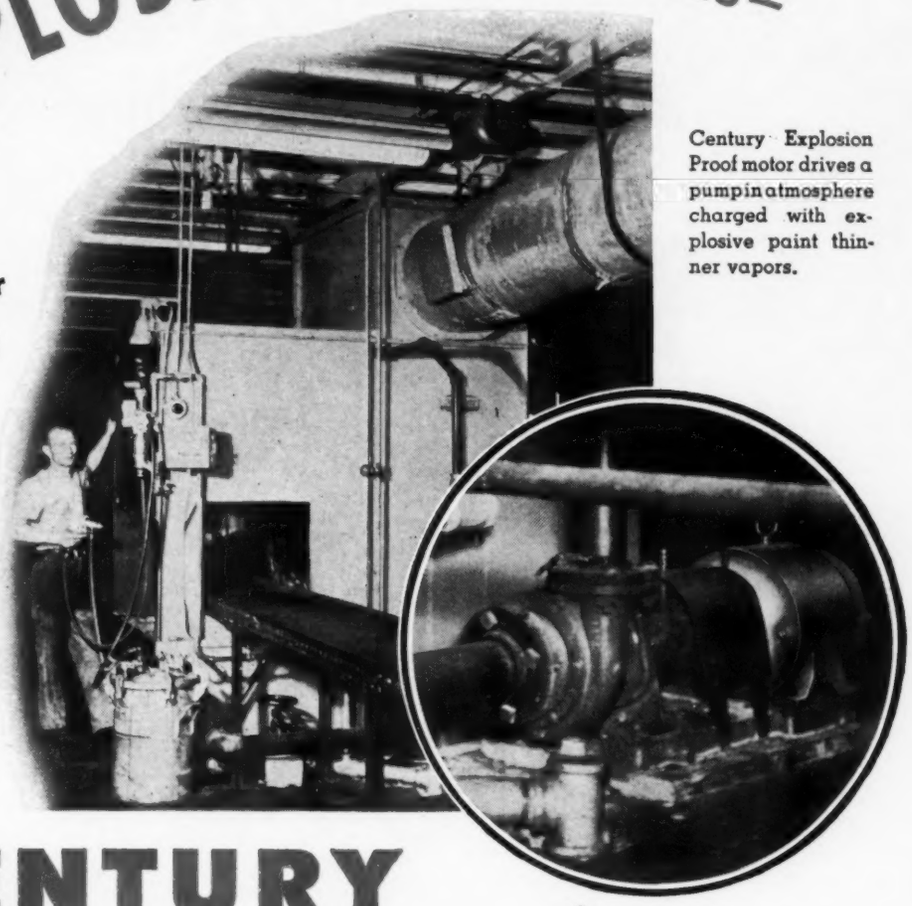

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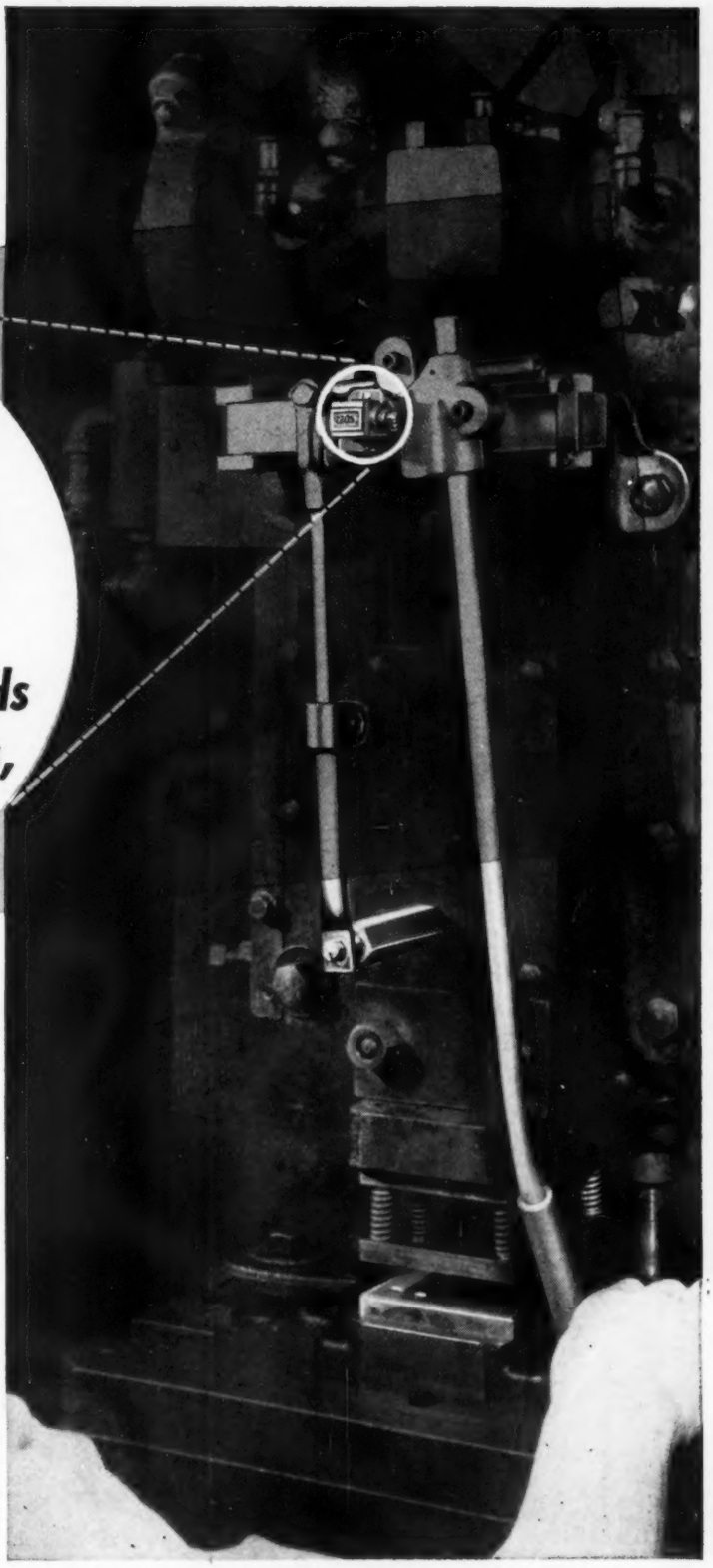

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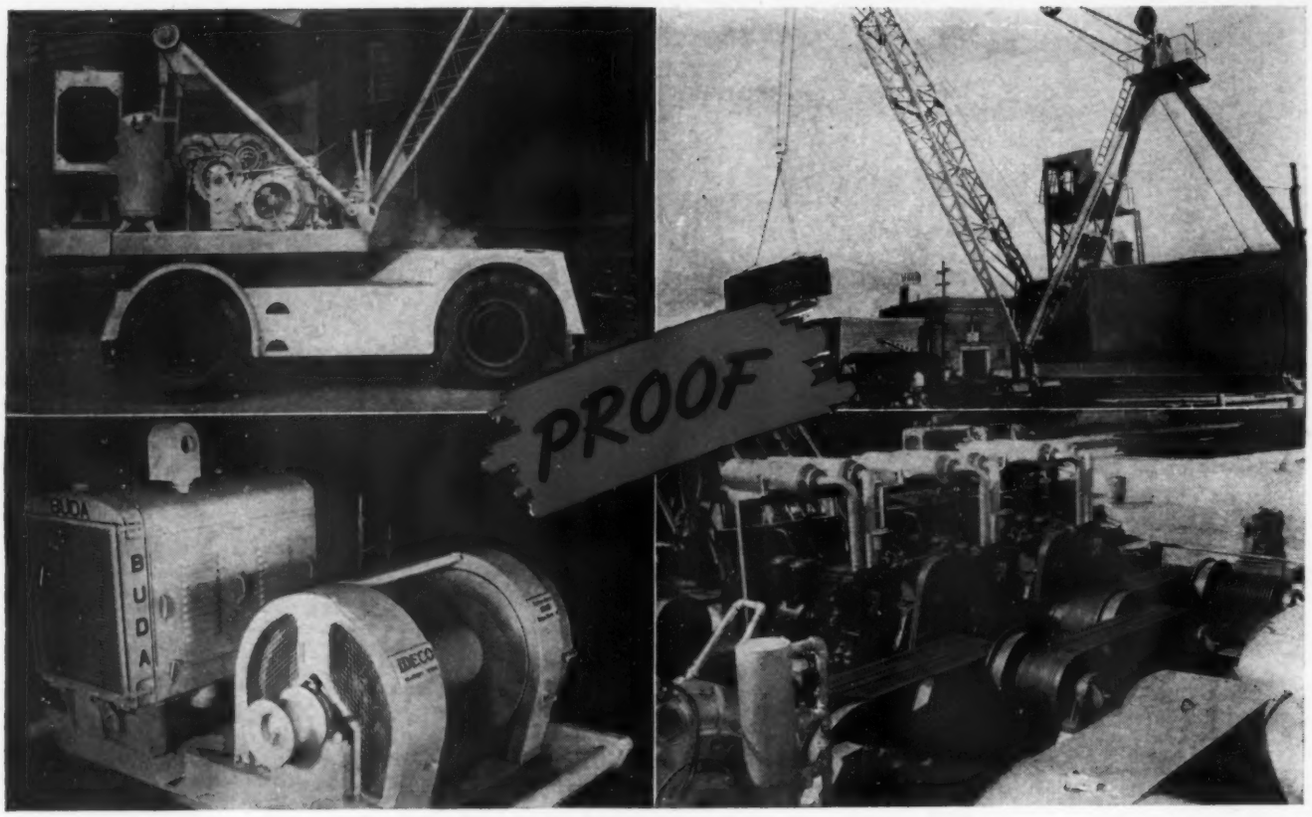

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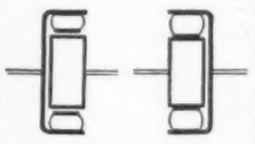

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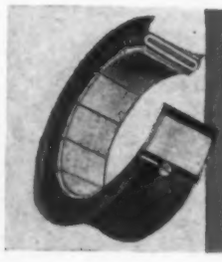

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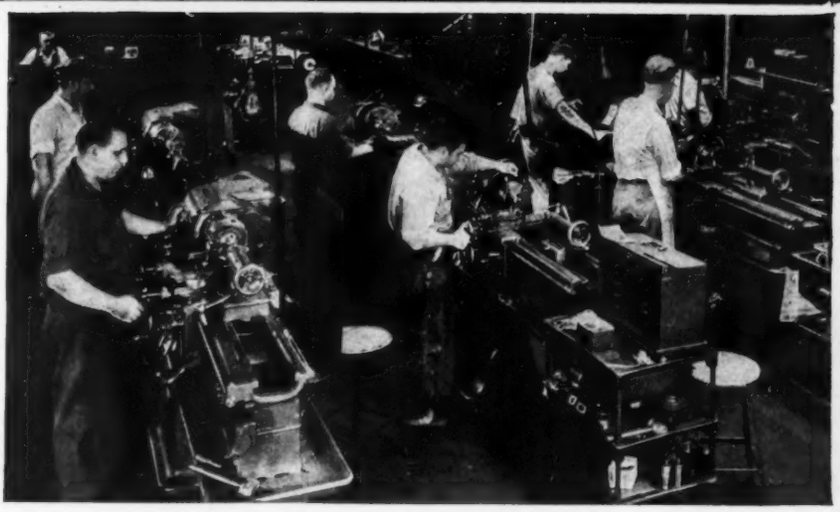

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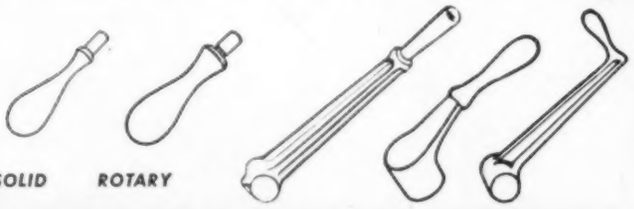

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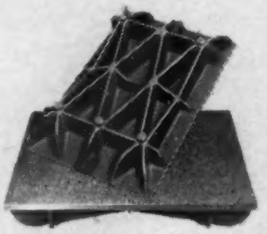

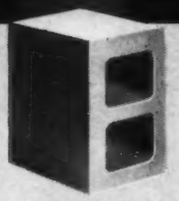

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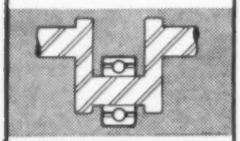

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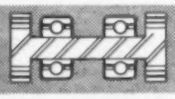

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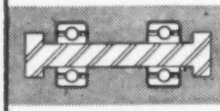

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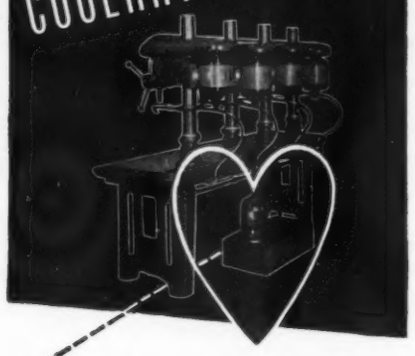

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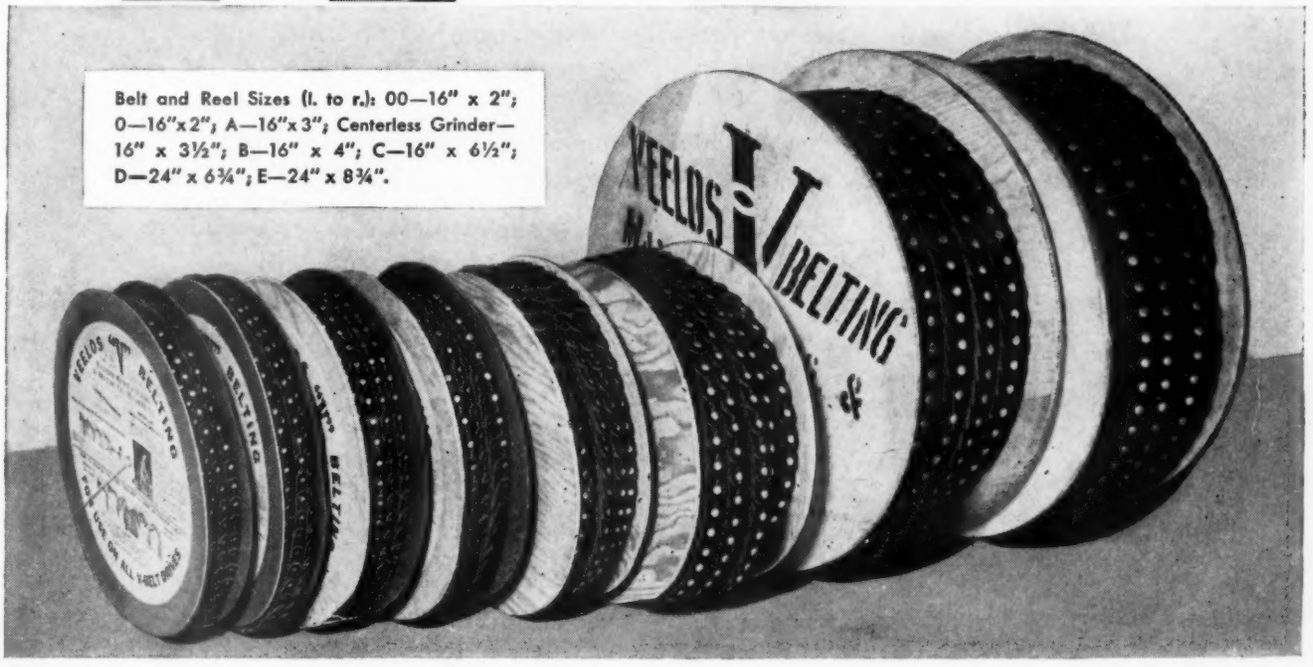

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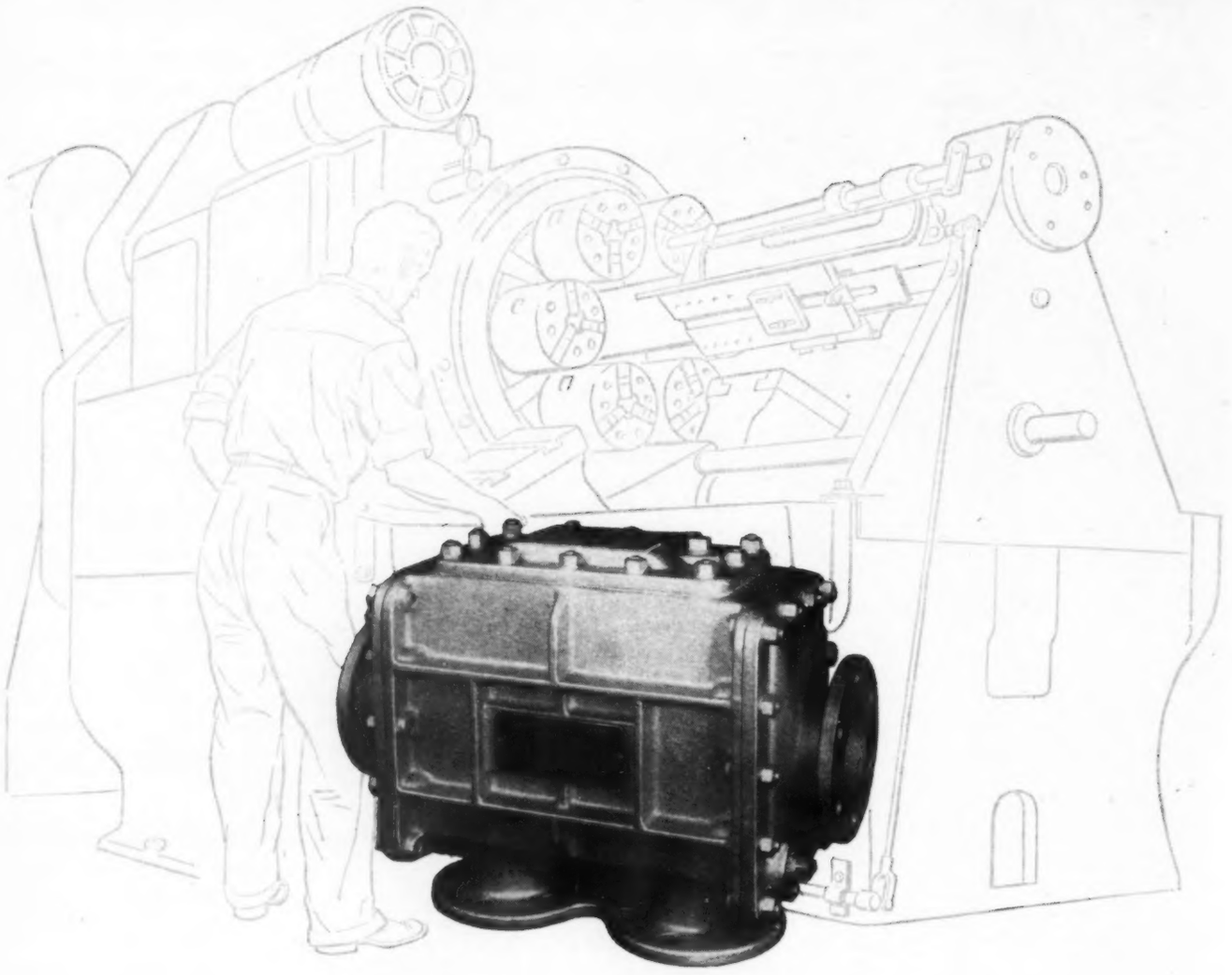

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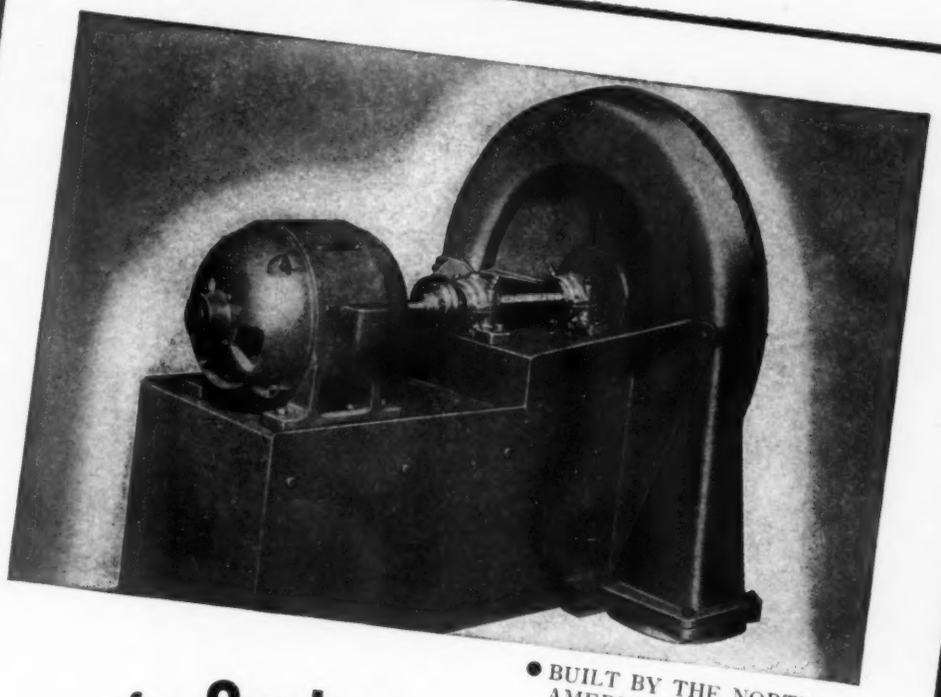

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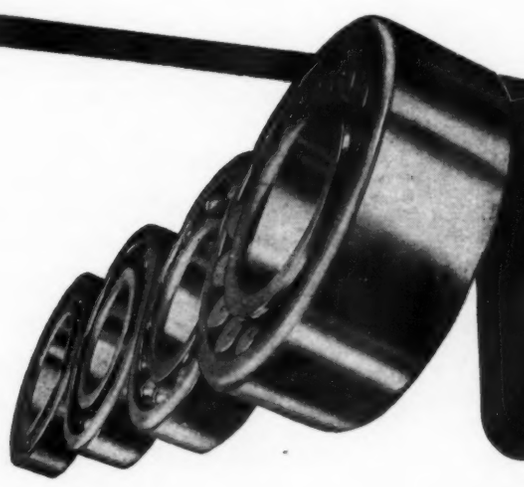

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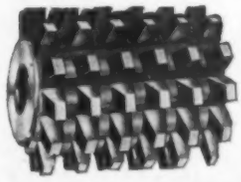

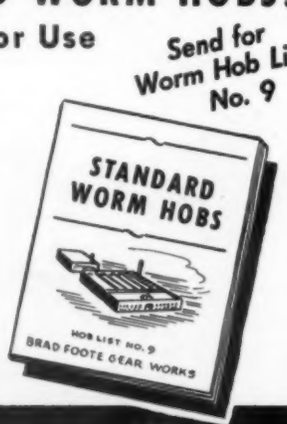

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SCREW TOP OILERS
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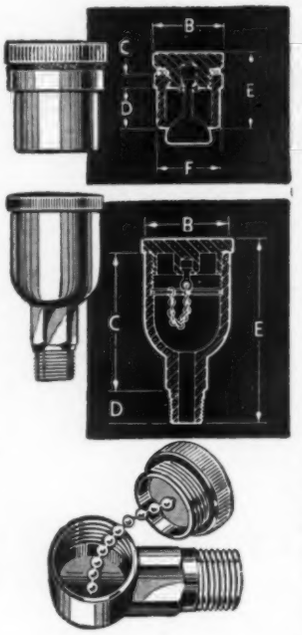

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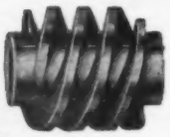

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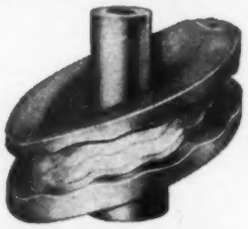

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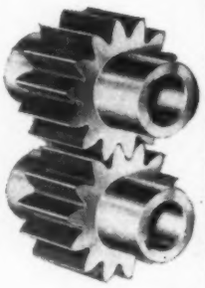

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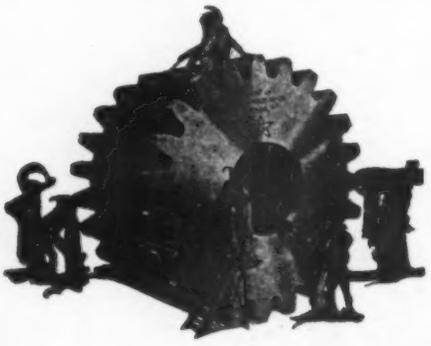

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Sier-Bath Gears have operated KEARFOTT MARINE WINDOWS FOR 23 YEARS

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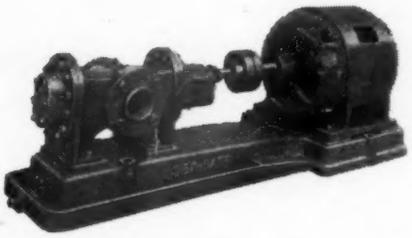

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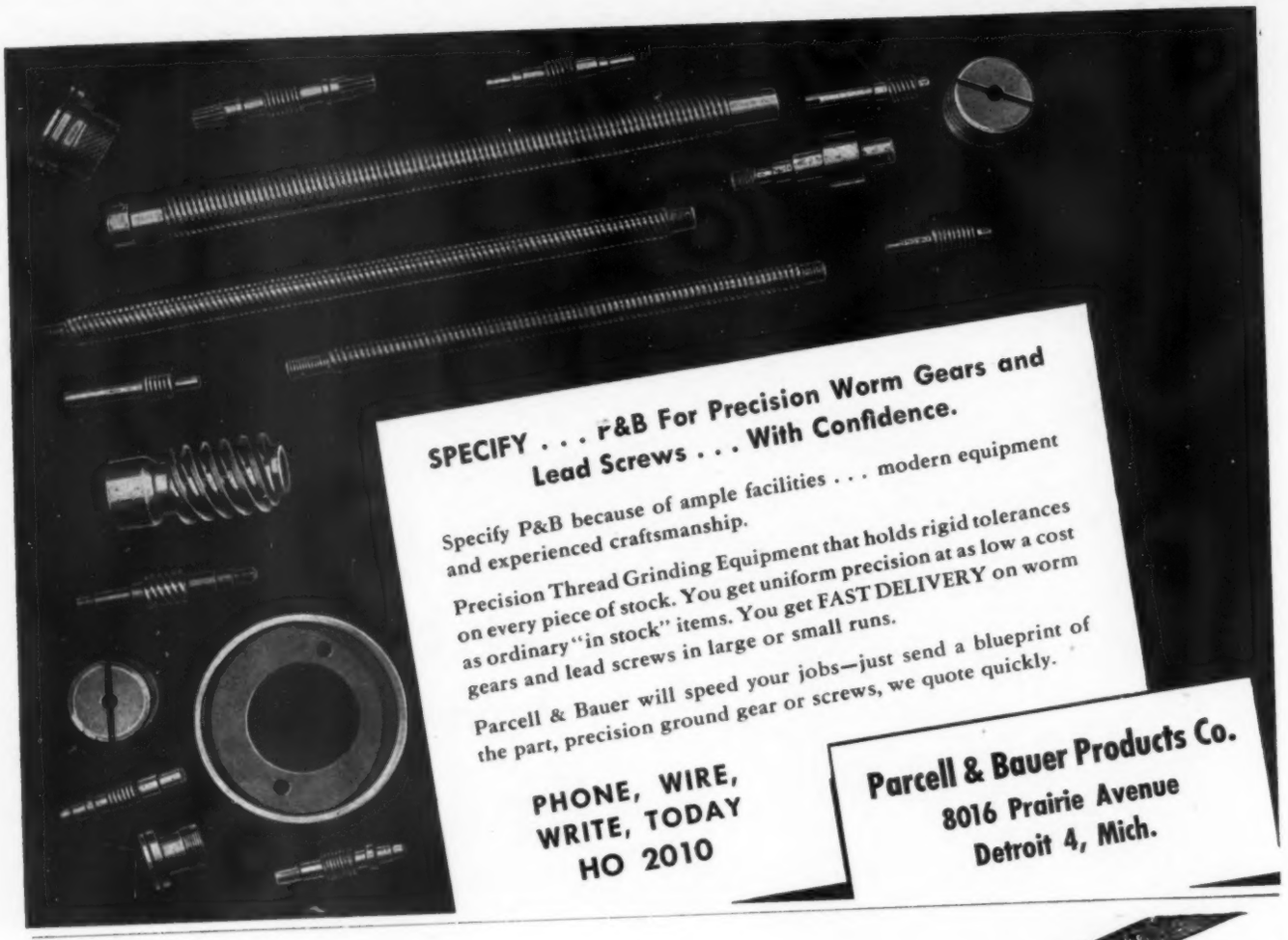
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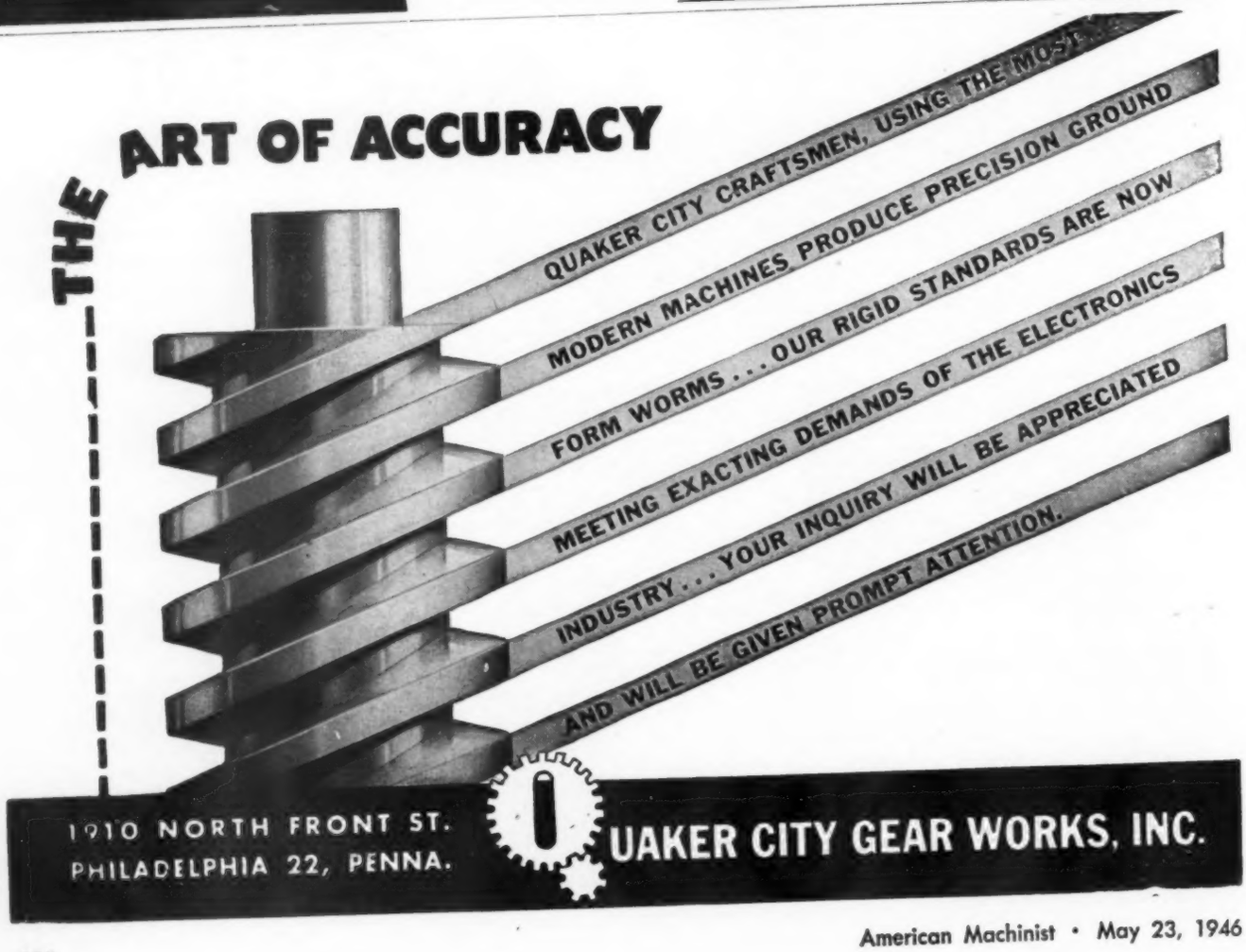
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AIRCRAFT QUALITY GEARS

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This Farrel precision generated internal spur gear has 108 teeth, 1½ DP, 4¾" face, 72.225" ID. The pinion has 13 teeth, 1½ DP, 5⅛" face, 10.358" OD.

In the swing mechanisms of power shovels and ladder trucks, in machine tools, and in numerous other applications, Farrel precision generated internal gears are giving efficient, long-life performance under severe operating conditions.

Their smooth, quiet operation is due to accuracy of tooth contour and tooth spacing inherent in the famous Farrel-Sykes method by which the teeth are generated.

You can get Farrel internal gears in any size up to 18-feet diameter, 12-inch face, 1¼ DP, precision generated with either spur or single helical teeth.

Internal gears frequently meet design and operating conditions better than other types and their availability in large sizes has extended their advantages to many applications where size limitations formerly prevented their use.

Next time you need internal gears, the facilities and experience of the Farrel organization in the design, manufacture and operation of gearing of all types are at your service.

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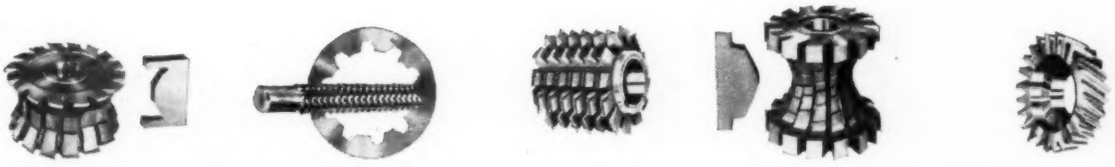

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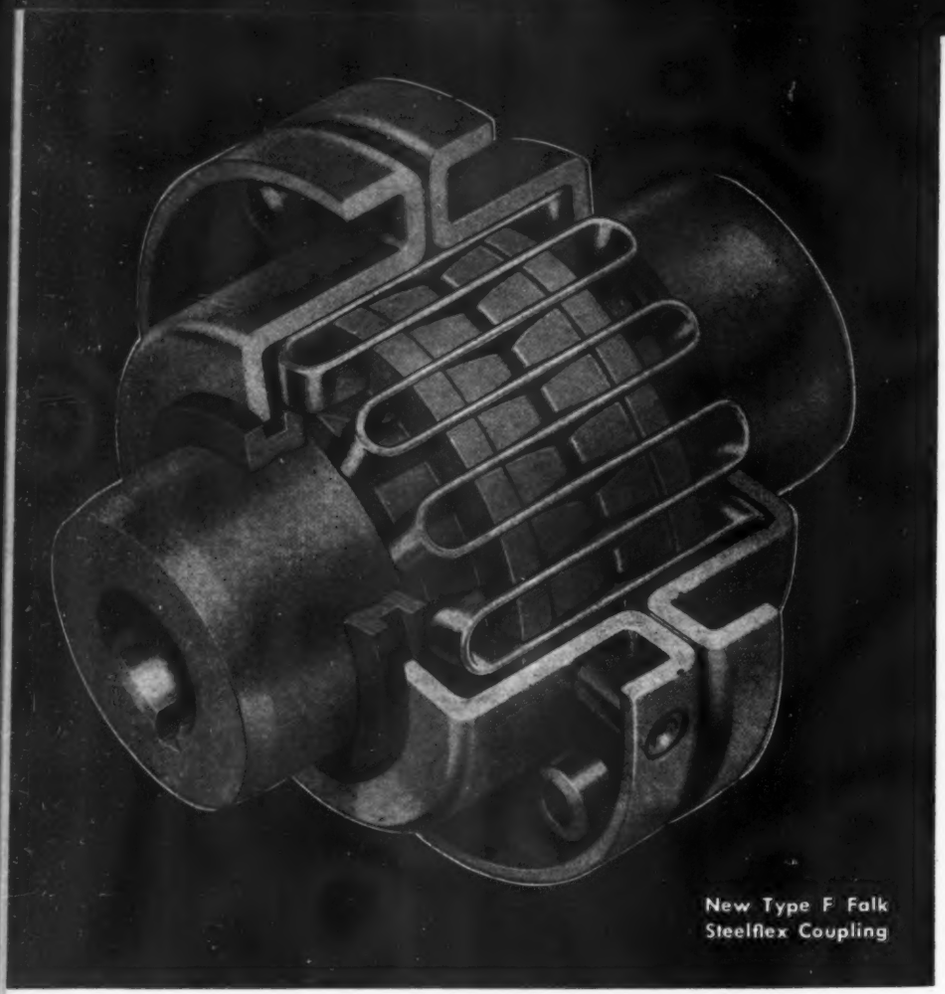


New Type F Falk Steelflex Coupling

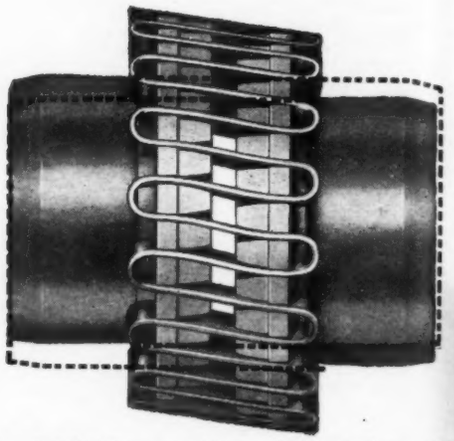
Only the FALK Steelflex Coupling Provides all the advantages of the GRID-GROOVE design

● Falk Steelflex Couplings are notable for their grid-groove design. The grid-groove is the net result of long experience in gear design. This is important, because in most cases a coupling is used in conjunction with a driven machine involving the use of gears.

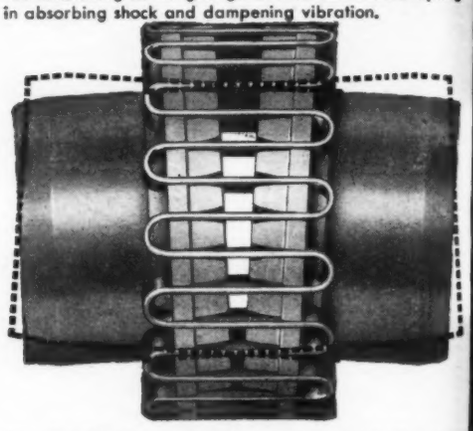
The long experience of Falk engineers in designing gears has been responsible for coupling design which not only provides the flexibility long considered essential but also provides the torsional resilience which enables Falk Steelflex Couplings to transmit power smoothly, efficiently, with an almost total elimination of the effects of shock, to dampen vibration, and to cushion the load even under severe peaks.

How and why only the Falk Steelflex Coupling provides all the advantages of grid-groove design is described at the right. If you are skeptical, so much the better. Then you will study this data with a greater appreciation for the unusual performance and life provided by Falk Steelflex Couplings.

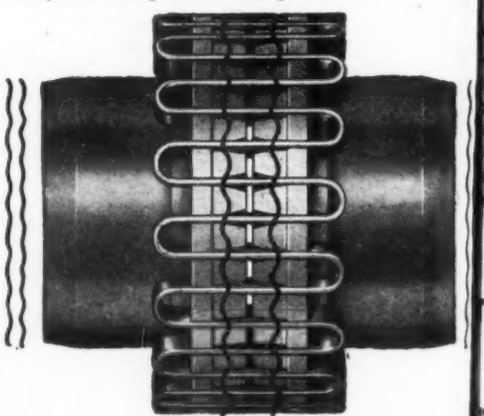
A Checkl



Parallel Misalignment. When parallel misalignment is involved, the grid-groove combination comes into full play. The movement of the grid in the lubricated grooves accommodates the misalignment, while still permitting full functioning of the grid-groove action of the coupling in absorbing shock and dampening vibration.



Angular Misalignment. Under angular misalignment the design of the Falk Steelflex Coupling permits a rocking and sliding action of lubricated grid and hubs that allows the greatest freedom of accommodation to angular misalignment, while at the same time transmitting the power through the resilient grid.



Free End Float. Because the grid member slides freely in the lubricated grooves, the Steelflex coupling permits unrestrained end float for the shafts of both the driving and driven members, or of either one. If it is desired that end float be restricted, provision can be made to limit it to any required amount.

list for Skeptical Coupling Buyers...

✓ Flexibility

✓ Torsional Resilience

✓ All Steel Construction

✓ One type fits 90% of all Applications

The new improved type F Falk Steelflex Coupling offers even greater evidence to convince the intelligently skeptical buyer. It offers one type of coupling that fits 90% of all installations, horizontal or vertical. It offers new ease of alignment . . . misalignment flexibility . . . floating cover sealed with wider Neoprene seal rings to afford even better protection against loss of lubricant . . . identical cover halves . . . identical hubs, each of which can be bored and key seated for various shaft diameters.

In addition to the standard type F coupling Falk offers a line of large Steelflex Couplings and couplings featuring the Steelflex principle but used for special service and dual-purpose applications. For specific information and recommendations, call the nearest Falk representative or distributor.

A new Falk Coupling Bulletin contains full information on the design of this new coupling, a simplified method for selection, load classification, service factors, and dimensions. Send for your copy.

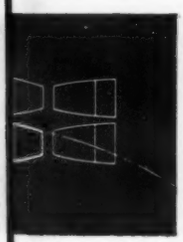


Fig. I

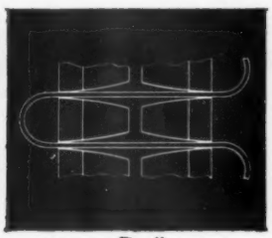


Fig. II

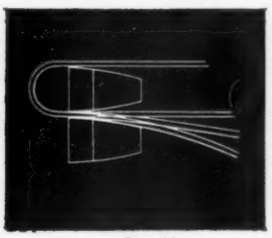


Fig. III

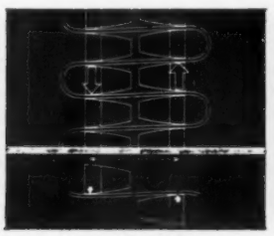


Fig. IV

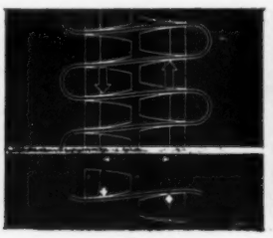


Fig. V

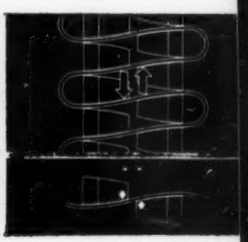


Fig. VI

Fig. I. Grooves, in a precise arc, and with a radius and length proportional to the capacity of the coupling, are cut into two identical hubs of moderately high carbon steel—forged of Falk alloy cast steel . . . *Fig. II.* These grooves provide a slot for a grid member made of chrome alloy steel with an elastic limit of 180,000 pounds per square inch and an ultimate strength of 220,000 pounds per square inch . . . *Fig. III.* This grid fits snugly into the curved grooves cut into the hubs of the coupling. The grooves provide a scientifically cut bearing surface for the grid. This bearing surface extends from the outer to the inner edge of the grooves. The grid bears on the grooves in proportion to the load . . . *Fig. IV.* Under light loads, the grid bears only at the outer edges of the grooves. This permits a long, free, elastic span between the outer edges of both hubs. Power is transmitted through almost the entire length of the grid rung . . . *Fig. V.* Under normal loads, the grid bears on a larger area of the grid grooves and the span of the grid run is shortened. It transmits more power and maintains its capacity to absorb shocks and dampen vibration . . . *Fig. VI.* Under peak loads, the grid rungs bear over almost all of the curved surfaces of the grooves. The span of the grid rung becomes very short. Under the impact of shock loads the grid flexes and continues to transmit power smoothly.

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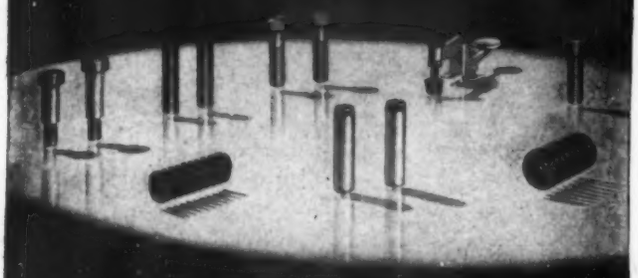

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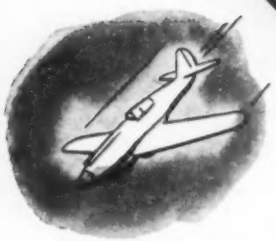

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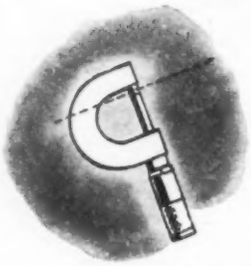

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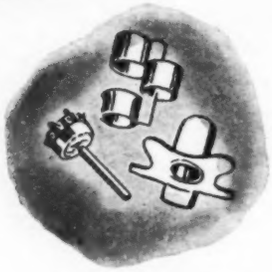
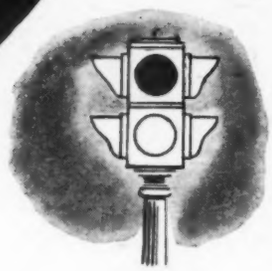
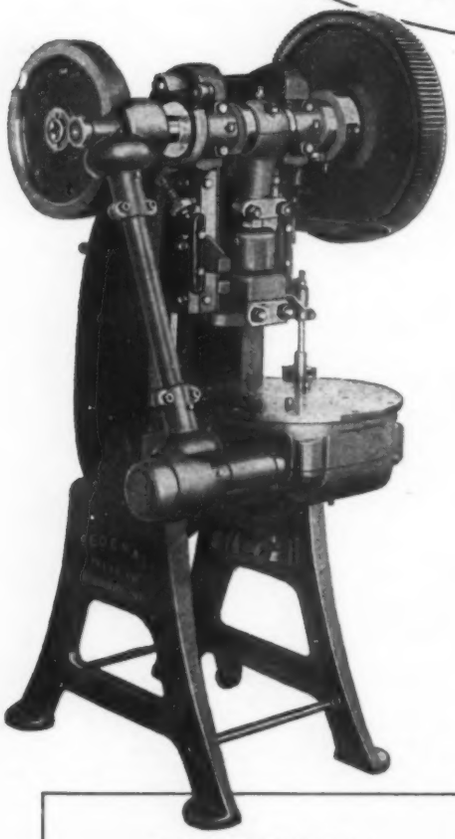


VERSATILITY



SAFETY



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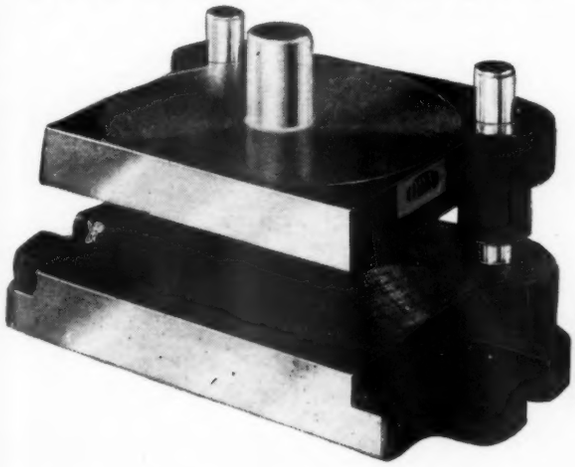

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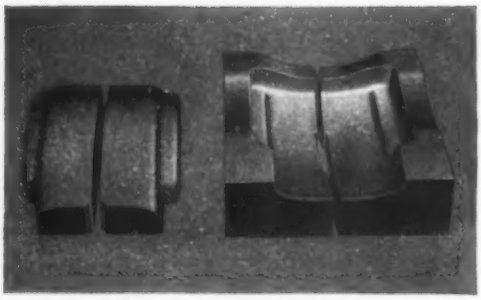

Automobile fender guards, punches and dies, an example of dies which are cast-to-shape from JESSOP steels.

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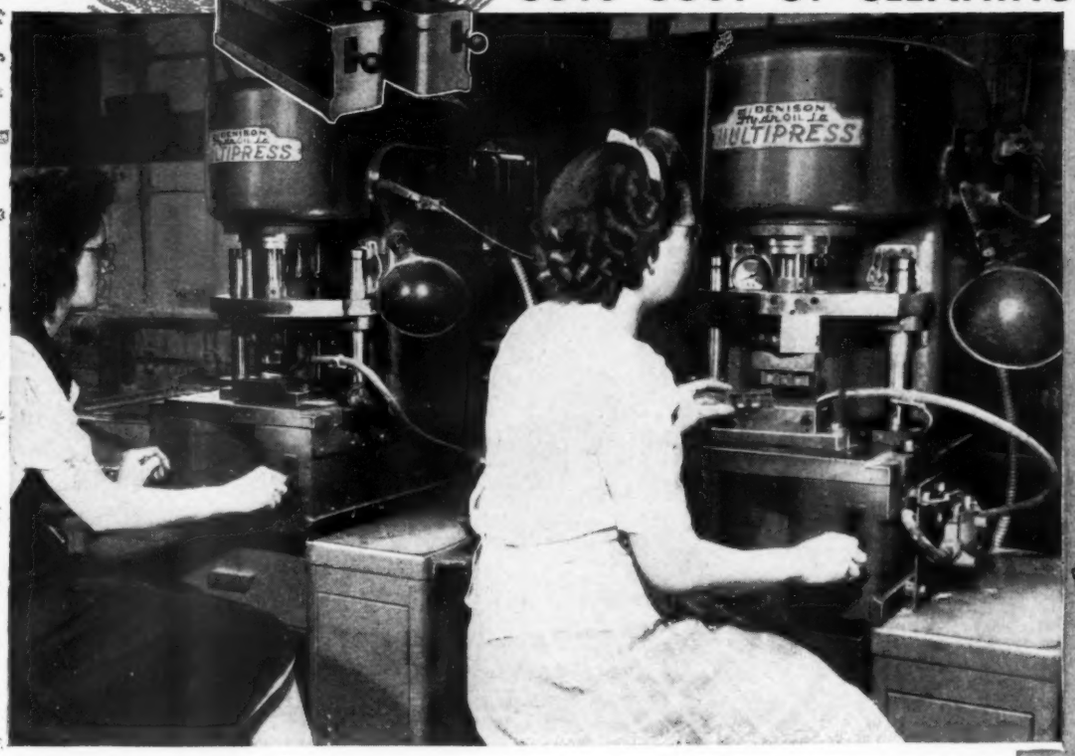

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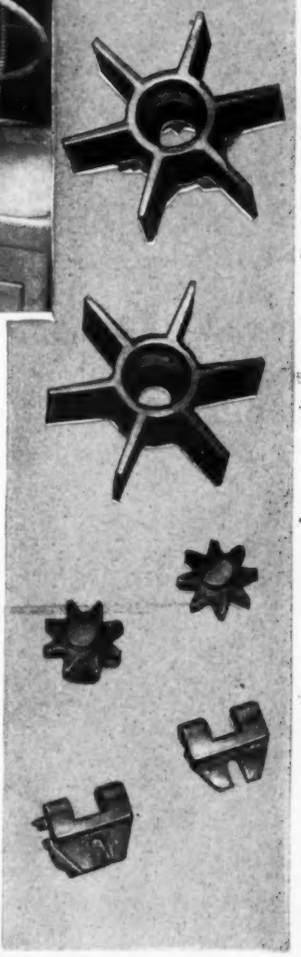

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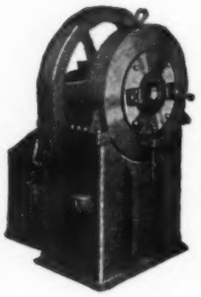

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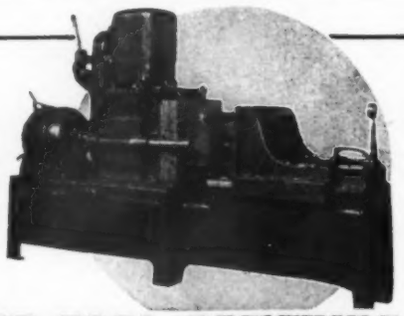

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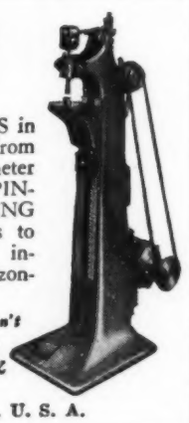

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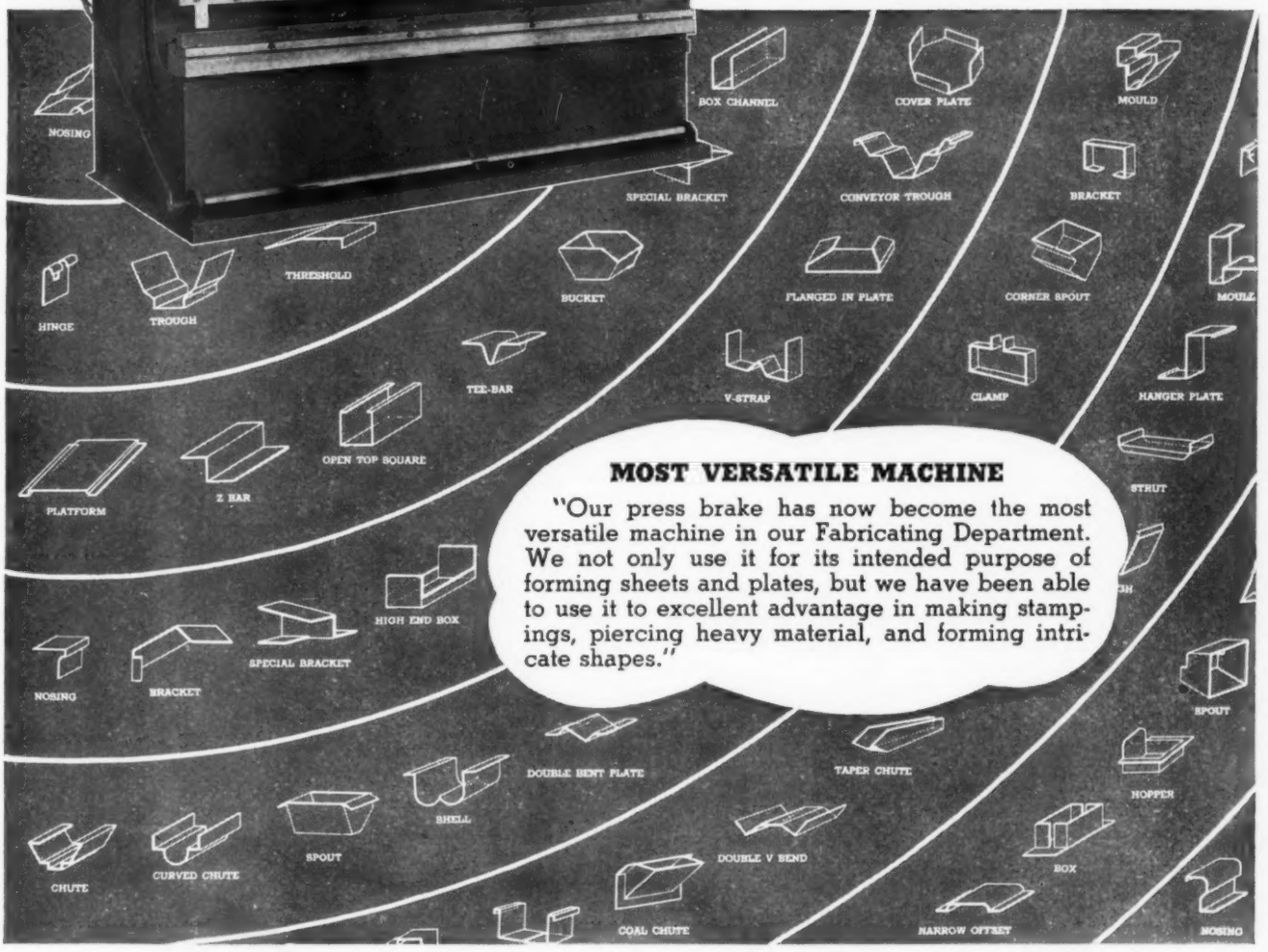

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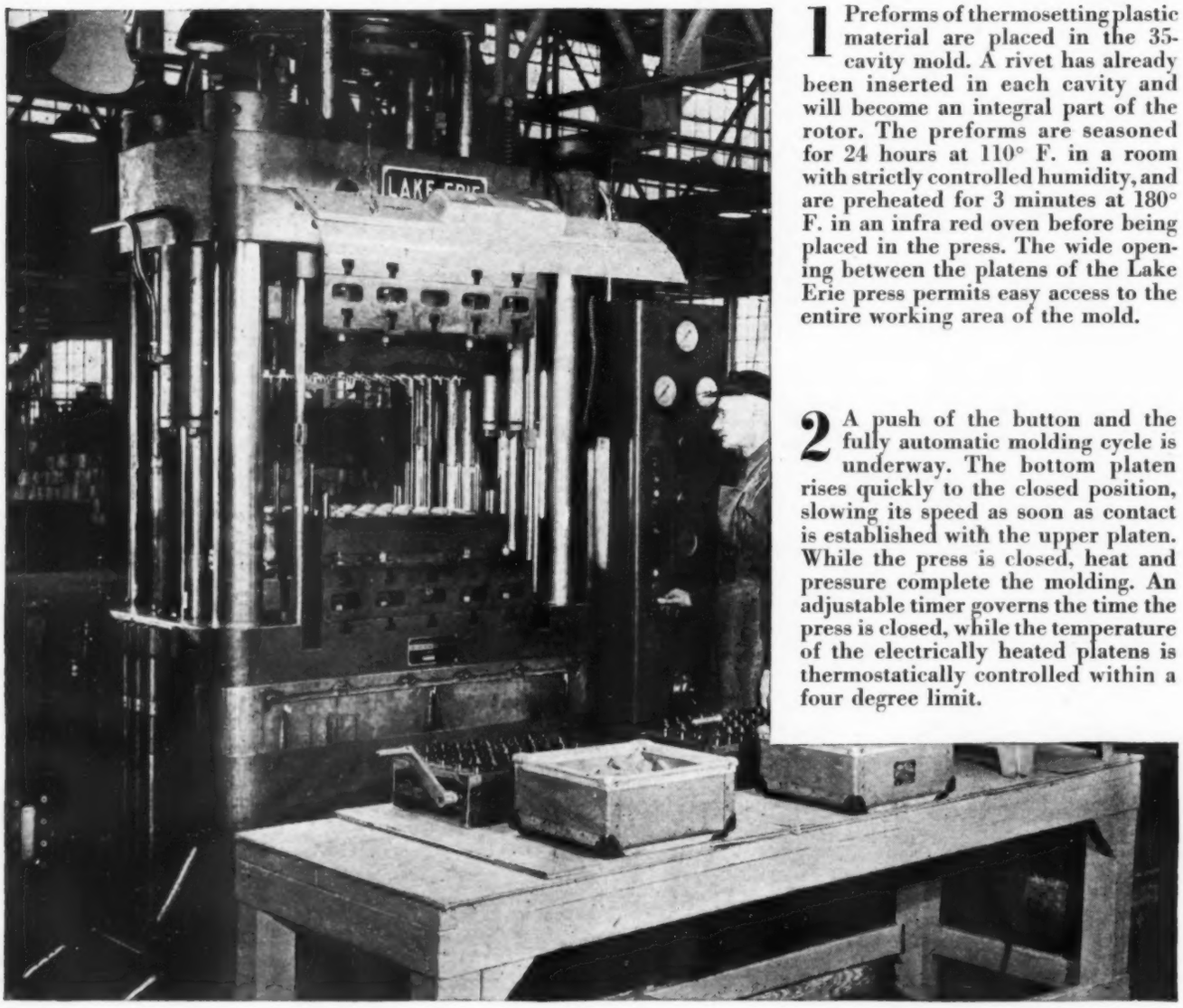
How the Ford Motor Company

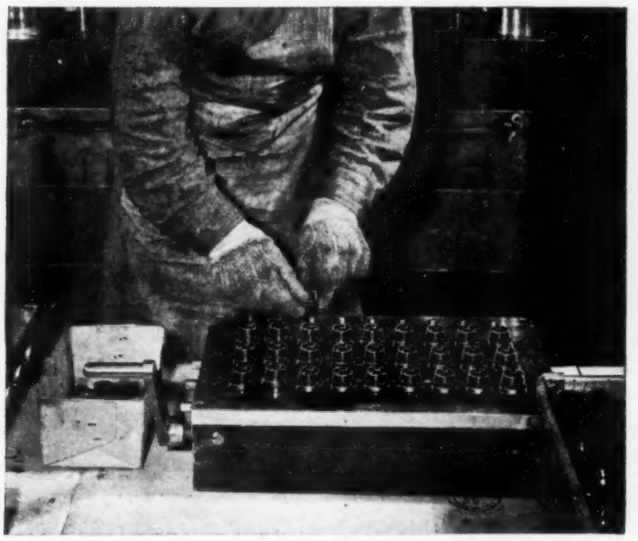
Rotors are turned out at the rate of more than 150 per hour on this 300-ton automatic Lake Erie Hydraulic Press at the Rouge Plant.



1 Preforms of thermosetting plastic material are placed in the 35-cavity mold. A rivet has already been inserted in each cavity and will become an integral part of the rotor. The preforms are seasoned for 24 hours at 110° F. in a room with strictly controlled humidity, and are preheated for 3 minutes at 180° F. in an infra red oven before being placed in the press. The wide opening between the platens of the Lake Erie press permits easy access to the entire working area of the mold.

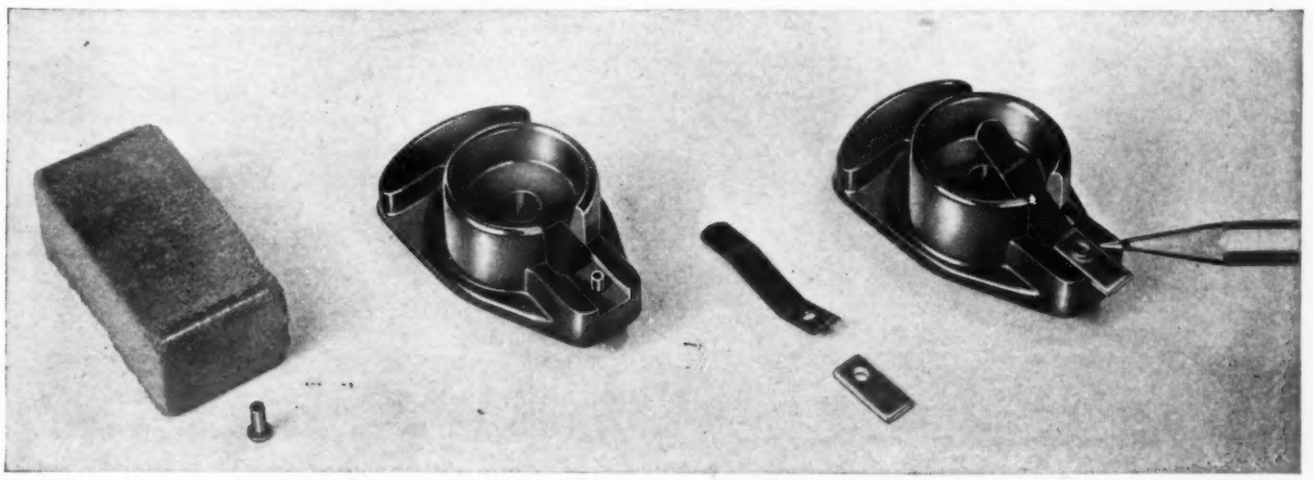
2 A push of the button and the fully automatic molding cycle is underway. The bottom platen rises quickly to the closed position, slowing its speed as soon as contact is established with the upper platen. While the press is closed, heat and pressure complete the molding. An adjustable timer governs the time the press is closed, while the temperature of the electrically heated platens is thermostatically controlled within a four degree limit.

produces Distributor Rotors...



3 When the molding cycle is completed—the press is closed for 5 minutes at 300° F.—the Lake Erie Press automatically opens to its full width. The operator then removes the molded rotors and flash or excess material. Within 2 minutes after the molded rotors are removed from the Lake Erie press, they are placed in the ingenious cooling fixture shown in 4.

4 The rods on which the rotors are being mounted are exact duplicates of the rods on which the rotors will be assembled in the distributor. In cooling to room temperature, the rotors shrink onto the rods and are held to within 2/10,000 of an inch of the exact fit required for installation in the Ford engine. A turn of the crank strips the cooled rotors from the rods.



Various stages in the manufacture of Ford rotors. At the left is the preform of thermosetting plastic material and the rivet which is integrally molded in the rotor. Next is the molded rotor with steel spring and brass tongue ready for assembly. At the right is the completed rotor. The pencil gives an idea of the small size of the parts and the need for precision presses and molds in manufacturing this vital Ford part.

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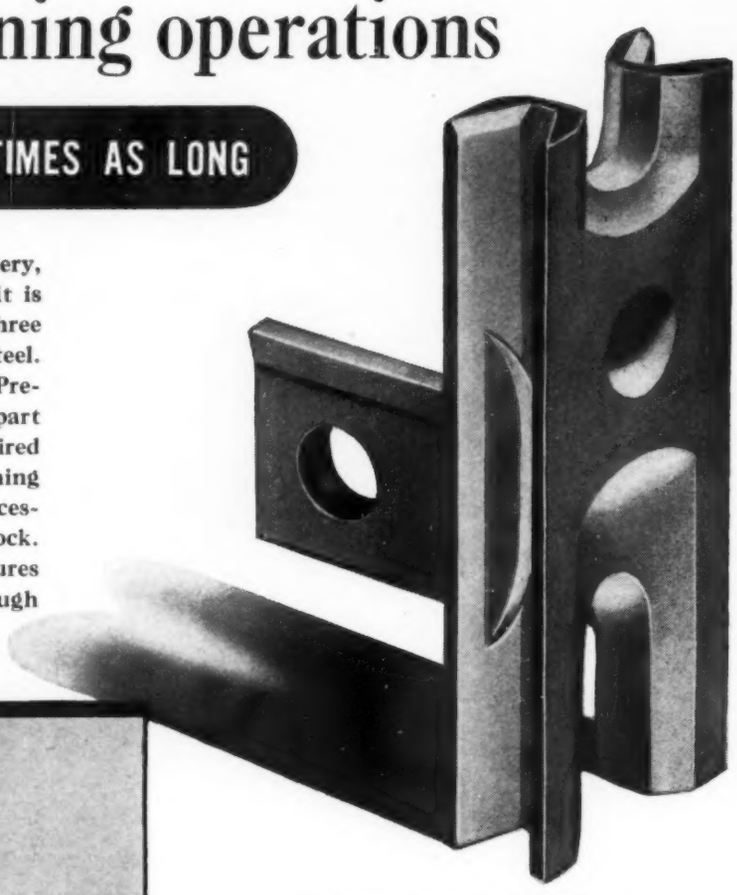

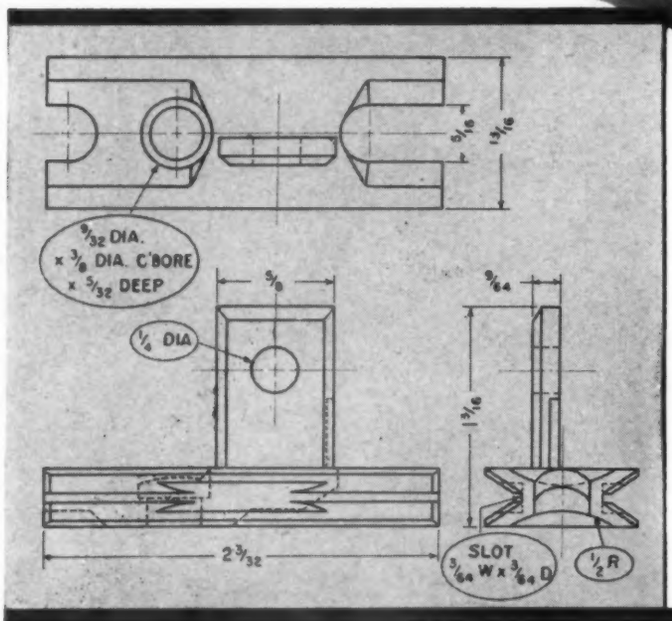

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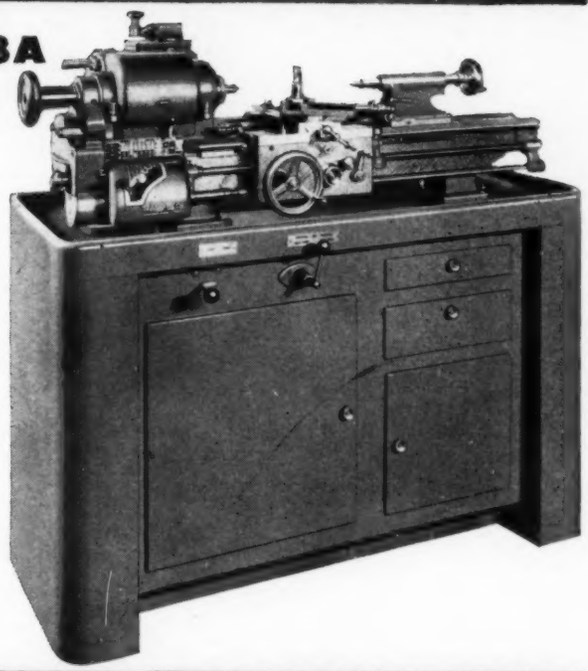

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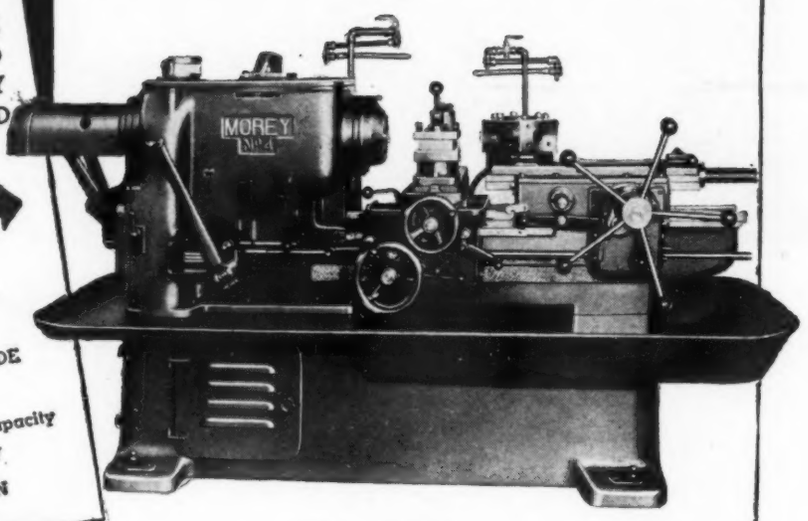

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Did you ever hear of a transmission going haywire on a TANNEWITZ DI-SAW? No, neither did we, though we have been making die saws for a good many years. And that's just typical of the superior construction of the entire machine. It can take the severest kind of use and always be ready for the next job. Moreover the standard model has larger wheels than customary in machines of this type — a full 24 inches — for greater traction, straighter, faster sawing and more production. Get the complete facts and you'll discover why TANNEWITZ DI-SAWS always show the best possible return on an investment in equipment of this kind. Write for "DI-SAW" Bulletin.

OTHER MODELS TO HANDLE WORK OF ANY SIZE

for dies, jigs and other work too large to handle on the standard machine. Bulletin on request.

THE TANNEWITZ WORKS
GRAND RAPIDS 4, MICHIGAN

BURKE MILLING MACHINES

. . . Put Your Small Work on a Production Basis!

Those small, difficult jobs can be handled on a *production basis* with BURKE Motor Driven Milling Machines Nos. 1, 2, 3, & 4. Primarily, this is because BURKES have been *specially designed and built* to do smaller milling jobs efficiently and economically.

Then, too, a number of attachments are available . . . attachments that increase the units usability, and add to your productivity. These include a vertical milling attachment, index centers, and vises—3 types, including swivel base. Now, when production must be stepped up, is the time to investigate the profit possibilities of BURKE Milling Machines, as applied to your work.

Complete Information Will Be Sent You Upon Request — Write!

BURKE MACHINE TOOL CO.
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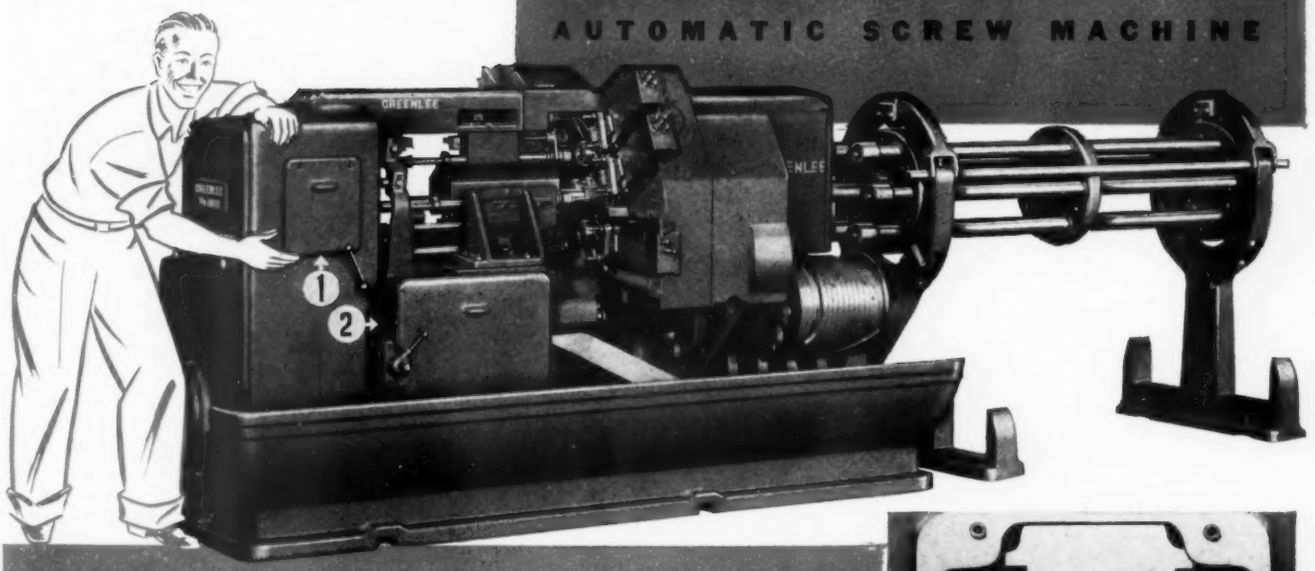
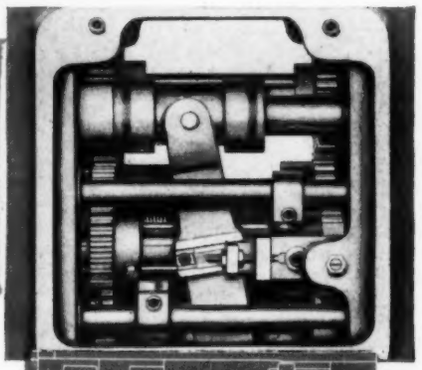
A VERSATILITY FEATURE OF THE

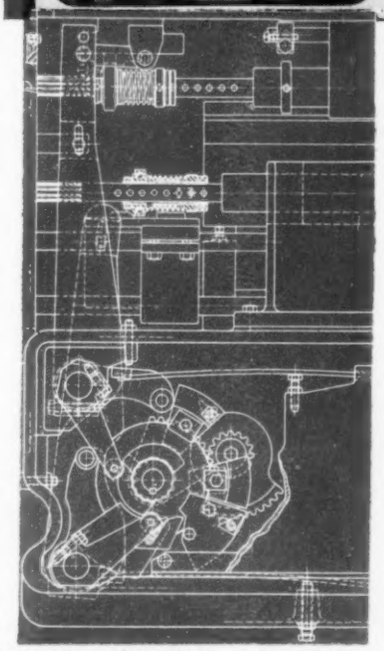
GREENLEE "6"

AUTOMATIC SCREW MACHINE



BUILT-IN THREADING AND TAPPING MECHANISMS FOR FOUR POSITIONS





CONVENIENTLY LOCATED. The gear box (1) and the threading box (2) contain the built-in drive and feed mechanism available as standard equipment on the GREENLEE "6" for any desired threading, tapping, or reaming operations in the 3rd, 4th, 5th, and 6th positions.

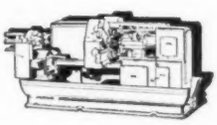
HANDY FOR SET-UP. Removing the cover of the gear box (1) gives access to the duplex clutch and shifting lever and to the trip collars on the control rods. Taking off the cover on the threading box (2) permits quick access to the adjustable forward feed and return cams which govern the travel of the threading spindles. Other adjustments are in the open tooling area.

VARIETY OF WORK. A broad range of settings are available at all adjustment points to handle a wide variety of standard threading, tapping, and reaming operations. Special threading and tapping equipment, with lead screw drive, can be supplied when needed for high-precision work. Also, double clutches can be furnished for simultaneous right-hand and left-hand threading. A sensitive threading spindle is available for cutting fine delicate threads.

OTHER FEATURES. The GREENLEE "6" has many other features which contribute to efficient, accurate work and quick change-over. Write for a copy of our 20-page descriptive bulletin "Greenlee Automatic Screw Machine" today and learn why the GREENLEE "6" is often called "The Operator's Favorite".

PRODUCTION MACHINERY

GREENLEE

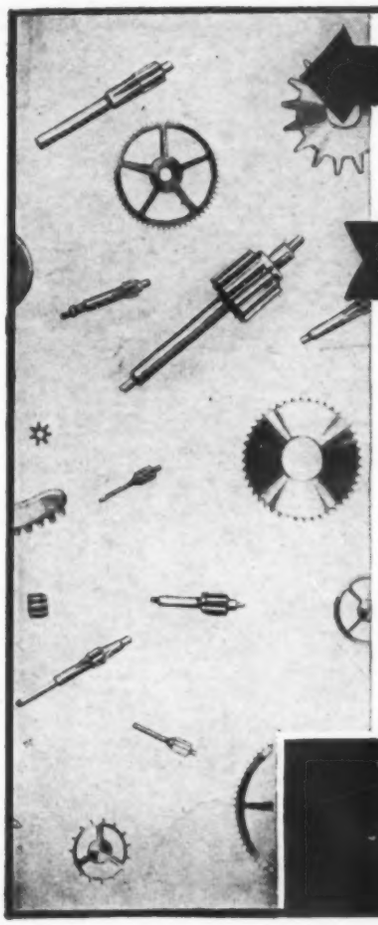


GREENLEE BROS. & CO.

1725 MASON AVE., ROCKFORD, ILLINOIS

WRITE TODAY FOR MORE FACTS

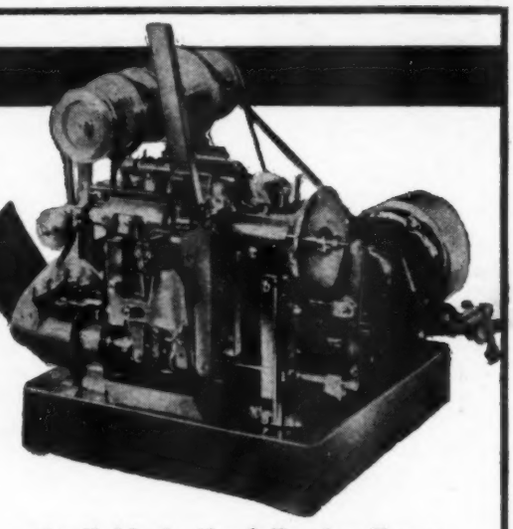
MULTIPLE-SPINDLE DRILLING, BORING, TAPPING MACHINES • AUTOMATIC SCREW MACHINES • AUTOMATIC TRANSFER PROCESSING MACHINES



Parts like these

are produced quickly and accurately on

WALTHAM
PINION & GEAR CUTTING MACHINES



These bench machines, for cutting fine pitch gearing, such as those used in watches, instruments, time fuses, etc., employ a revolving cutter which makes successive cuts. Blanks are held and indexed by the work spindle. Only straight cuts can be made.

Cutter spindle is designed for high speeds. The entire machine is sturdily built for precision and long life. Each type machine is convenient, easy to operate and highly productive.

Full details and specifications are available on request.

Available in the following Types

In each of the following machines, the same cutting method is used, namely a revolving cutter which makes successive cuts on blanks held and indexed by work spindle.

Single-Cut Pinion Machines, Multiple-Cut Pinion Machines, Magazine-Fed Pinion Machines, Gear Cutting Machines

CAPACITY: Pinion Machines, ¼" dia.
Gear Machines, 1½" pitch dia.

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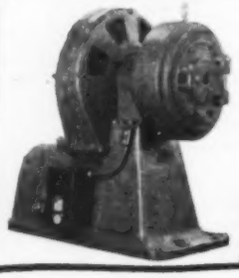
MACHINE WORKS,
WALTHAM, MASS.

"Ask ETNA about Swaging"



● If you have a production phase that calls for tapering, sizing or reducing of solids or tubes, you can save money if you "ASK ETNA ABOUT SWAGING." The superior performance of ETNA machines assures you more pieces per hour at lower cost. Built in capacities of ⅛" to 4" . . . larger sizes built to order!

Ask for our swaging catalogs

The ETNA MACHINE Co.
3400 MAPLEWOOD AVE. TOLEDO, OHIO

MILLHOLLAND

Automatic **DRILLING - BORING MILLING - TAPPING** *Units*

½ to 20 HORSEPOWER DRIVE

AUTOMATIC and SEMI-AUTOMATIC PRODUCTION MACHINERY

W. K. MILLHOLLAND MACHINERY CO.
Indianapolis, Ind.

CARLTON RADIAL DRILL

"Anti-friction Bearings Throughout"

FEATURES — 1. Low Hung Drive to the Spindle. 2. All Power Driven Parts Running in Oil. 3. Quiet Running at all speeds. 4. Concentrated and Convenient controls. 5. Constructed on Unit Principal.

The **CARLTON**
MACHINE TOOL COMPANY
CINCINNATI, OHIO, U. S. A.

ARMY E NAVY

IF YOUR AIM IS

Accuracy...

● Put the job on Kent-Owens Milling Machines... to get utmost *accuracy* in top-speed production! Your experienced operators will like the simple, efficient, practical operation of these machines. Ruggedly built... with a long record of unbeatable dependability. Adaptable to a wide range of work. Illustrated is the Kent-Owens 2-20 Milling Machine. Other models include the 1-14, 1-8, 1-V, 2-20V, 1-14V, 2-20DS, 1-14DS, 1-M and 2-RV. Write for latest bulletins. Kent-Owens Machine Company, Toledo, Ohio.

Specify

KENT-OWENS

Milling Machines

No. 2-20 Milling Machine Table, 42" by 12" Table travel, 20"

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BUFFALO — Don W. Patterson
CHICAGO — Neff, Kohlbusch & Bissell
DALLAS — Hamilton-Hunter Mach'y Co.
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DETROIT — A. C. Haberkorn Mach'y Co.
GRAND RAPIDS — Joseph Monahan
HOUSTON — Oliver H. Van Horn Co., Inc.
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KANSAS CITY — Eichman Machinery Co.
LOS ANGELES — Eccles & Davies Mach'y Co.
MILWAUKEE — Neff, Kohlbusch & Bissell
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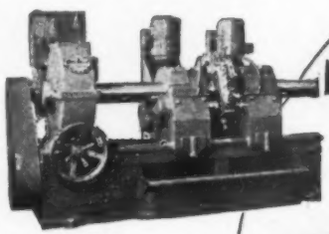
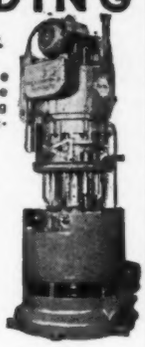
MILLING, DRILLING REAMING—

BORING and THREADING



PLANER TYPE MILLER
Open side, as well as, those with a combination of Vertical and Horizontal Heads are incorporated in this line.

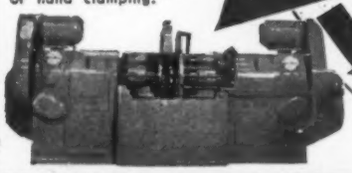
8 SV VERTICAL DRILLER
Operations are continuous of the non-indexing type. 8 or 10 spindles available.

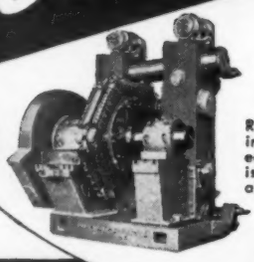


No. 1-A MILLER
One of a series of continuous operating milling machines adaptable to automatic or hand clamping.

Roto-Matic

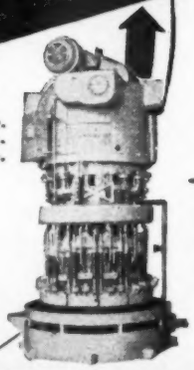
DOUBLE END HORIZONTAL DRILLER
12 to 24 Spindles—self feeding—continuous operation—automatic chain or hand clamping.





No. 4 MILLING MACHINE
Roughing and finishing cutter spindles in each column with finishing spindles adjustable for toe cut.

12 V VERTICAL DRILLER
Continuous operating having a capacity of 1½ in. in steel.



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Hollow steel frames of highest quality construction give a lifetime of accuracy. Special designs available.

FOR ADDITIONAL INFORMATION ASK FOR CATALOG A-90

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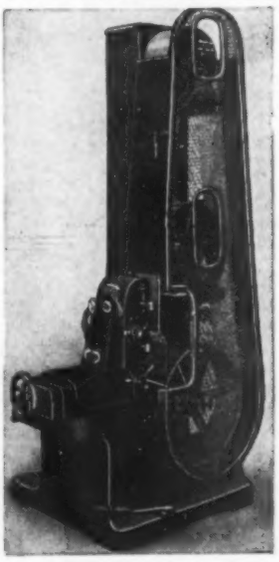
PIPE THREADING MACHINERY

MICROMETERS — SNAP GAGES
SPECIAL TOOLS AND GAGES

DAVIS & THOMPSON COMPANY

MILWAUKEE — MFRS. OF MACHINE TOOLS & MICROMETERS — WISCONSIN

NO CENTERING or CHUCKING on the "PRODUCTION" *Type A High Speed* POLISHING MACHINE



On this high speed machine work can be fed to a stop and finishing limited to that portion of the abrasive belt which is to be finished. Regardless of how used, this machine can be operated by unskilled labor with assured results in speed and high quality finish.

An outstanding advantage of the Type A Centerless Feed Polishing Machines, is the fact that no centering or chucking is required. Work is merely fed automatically by a power feed attachment.

A Taper Feed Attachment is available for this machine for feeding tapered cylindrical work.

Write for illustrated literature giving full information.

Specifications

Capacity (with power feed attachment)—¼" to 6" dia. Speed leather cushion belt—6300" per min. Floor Space—40" x 50". Motor—10 H.P.

PRODUCTION MACHINE CO.

Manufacturers of Tool Grinders and Hand and Automatic Polishing and Grinding Machines.

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GEAR CUTTING MACHINES

New Design
New Features
New Advantages

NEWARK GEAR CUTTING MACHINE CO.
69 Prospect Street, NEWARK 5, NEW JERSEY

FRANK E. EBERHARDT, *President*

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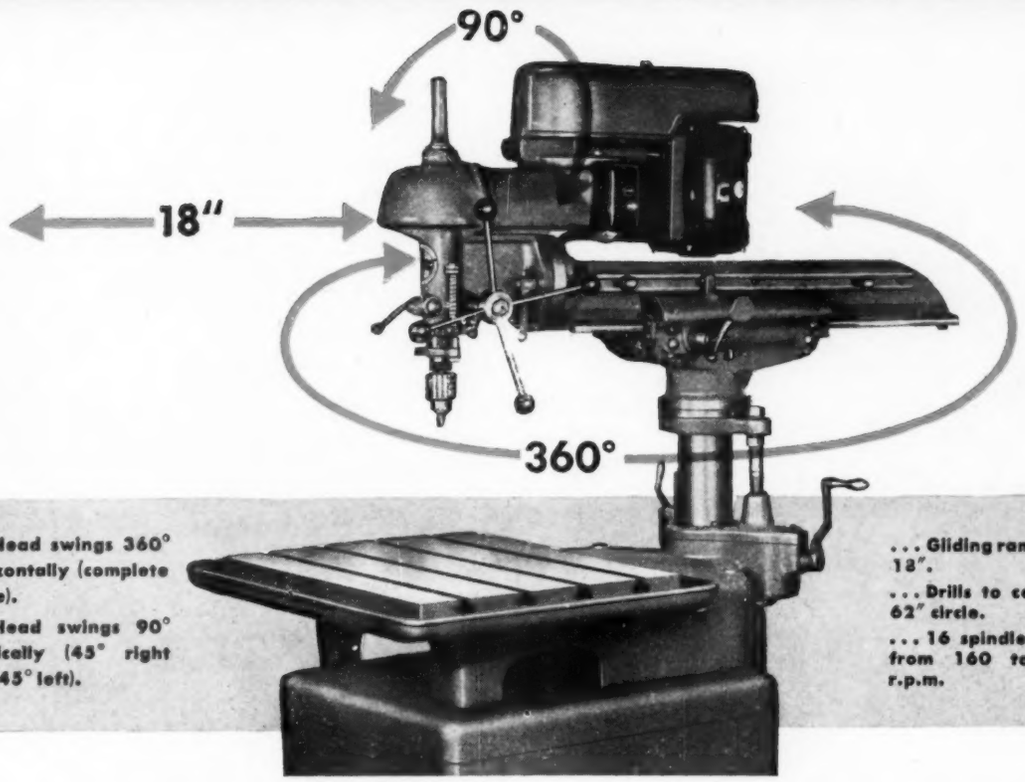
VERTICAL MILLERS
INJECTION MOLDERS

Get in the SWING and cut costs with Walker-Turner RADIAL DRILLS



. . . Head swings 360° horizontally (complete circle).

. . . Head swings 90° vertically (45° right and 45° left).

. . . Gliding ram travels 18".

. . . Drills to center of 62" circle.

. . . 16 spindle speeds from 160 to 8300 r.p.m.

IF you're drilling, tapping or reaming holes up to ½" in large workpieces . . . Walker-Turner Radial Drills are the answer for faster production and lower cost per piece.

Within their drilling capacity, these versatile machines have a greater range than standard drill presses . . . are easier to operate and simpler to control than heavy radials. Low first cost, low upkeep and low power consumption are other important advantages of Walker-Turner Radial Drills.

For complete description, send for our latest catalog.

Walker-Turner Company, Inc., Plainfield, N. J.

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MACHINE TOOLS

DRILL PRESSES — HAND AND POWER FEED • RADIAL DRILLS
METAL CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT-OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

these PLUS VALUES mean more output per man hour

1. Super-power for heavier cuts
2. Super-speed for faster cuts
3. Super-smoothness for finer cuts
4. Super-rigidity for truer cuts
5. Completely automatic cycles for easier cuts

LIPE *Carbo-Matic* LATHE

Will your second-quarter production be low?... your third-quarter labor costs be high? There's a way out—greater output per man hour and week. The Lipe Carbo-Matic Lathe will help you get it.

Super-powered for heavier cuts, it has a wide selection of speeds in the range best suited to carbide tools. Deflection and weaving are eliminated by a bed and headstock cast in one piece, and by a massive tailstock adequate to hold high-speed centers without vibration. Heavy bed sidewalls are reinforced by cross ribs spaced for maximum strength and high resistance to torsional stresses and strains. Chatter, tool wear and breakage are sharply reduced by the smooth-flowing power of a fully-enveloped cone-and-worm gear drive.

Completely automatic with a smooth flexibility of control that affords a larger number of set-up combinations for a greater variety of work, the Lipe Carbo-Matic holds operator motions to a minimum. There is a positive stop for all feeds, a time delay for "dwell", and a micrometer adjustment for depth of cut on all tool carriages. All contributing to more output per man and machine hour.

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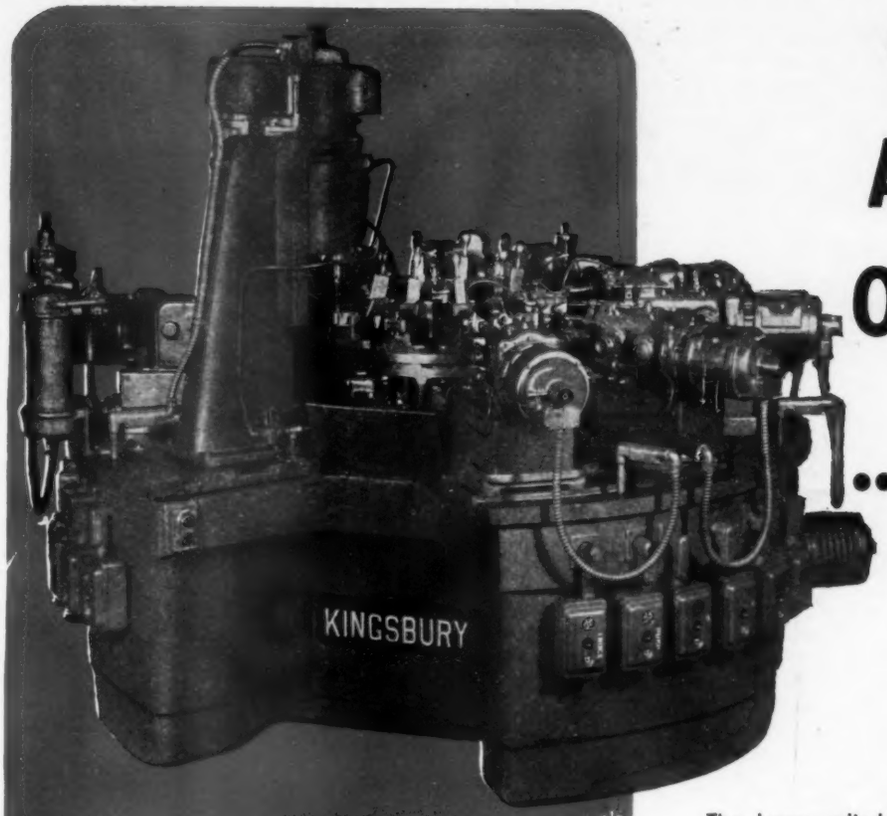
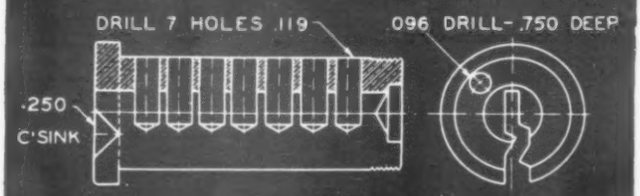
COMBINED AUTOMATIC OPERATIONS ...produce more parts!



A KINGSBURY AUTOMATIC INDEXING FLEXIMATIC *



PRODUCES BRASS CYLINDER PLUGS

REQUIRING 10 MACHINING OPERATIONS

IN 4.4 SECONDS

The brass cylinder plugs require drilling and countersinking as indicated on the drawing. The *Kingsbury Fleximatic* that does this complex job is assembled from nine *standard* Kingsbury drilling-head units and a *standard* Kingsbury base. The main indexing turret has ten duplicate work holders, nine of which are in working position while the operator loads and unloads the tenth. This means that the time of the longest single operation is the time to produce a finished piece.

The Kingsbury Fleximatic method is a means of performing automatically several machining operations accurately and quickly during a single chucking. It means that production of multiple machined parts can be increased, without overburdening operators, while production costs drop to a new low. Because *Kingsbury Fleximatics* are made up of *standard* units, initial cost is surprisingly small for a special-purpose machine tool.

Are you interested in producing more parts, faster, and more profitably, through combined operations? Send sample parts or blueprints to Kingsbury today. Our engineers will be glad to submit cost and production figures — there is no obligation.

WE PUT OUR HEADS TOGETHER TO CUT YOUR DRILLING COSTS

KINGSBURY
MACHINE TOOL CORP.
KEENE, NEW HAMPSHIRE

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*** KINGSBURY FLEXIMATIC**

— a special purpose machine for combined automatic operations during a single chucking —the result of Kingsbury engineering ability in the use of low cost *standard* Kingsbury drilling and tapping heads on *standard* Kingsbury bases.

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1200 THREADS an hour

Part: Container Shaft 8¼" long
Thread: .800"—16 NS
Material: Steel—WDX 1314

Rolled by **Precision Dies** *on the* REED Cylindrical-Die THREAD ROLLER

Developed to a high degree of controlled accuracy, modern thread rolling now gives you both QUALITY and QUANTITY.

√ *Lower Cost* √ *Wider Versatility*
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√ *Greater Uniformity* √ *Increased Strength*

Submit your threading problems to our engineers. Write for folder "THREAD ROLLING In Action".

The REED Cylindrical-Die Thread Roller adds wider range, simple and more precise controls, and greater versatility to the recognized advantages of thread rolling. Prices and specifications upon request.

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Thread Rolling Dies and Machines
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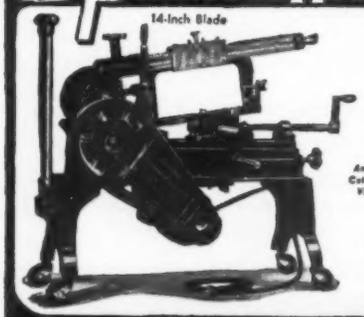

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This low cost machine will handle internal keyseating jobs up to 1¼ in.

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Giant KEYSEATERS

For cutting internal keyways, slots or splines 1/10" to 4" wide and up to 60" long. Fast—Accurate—Flexible. Write for particulars and catalog on machine for your work.

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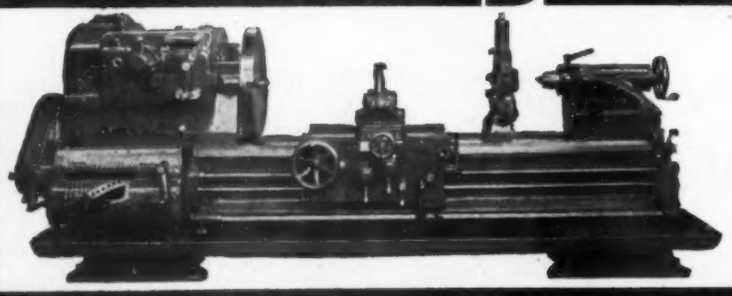
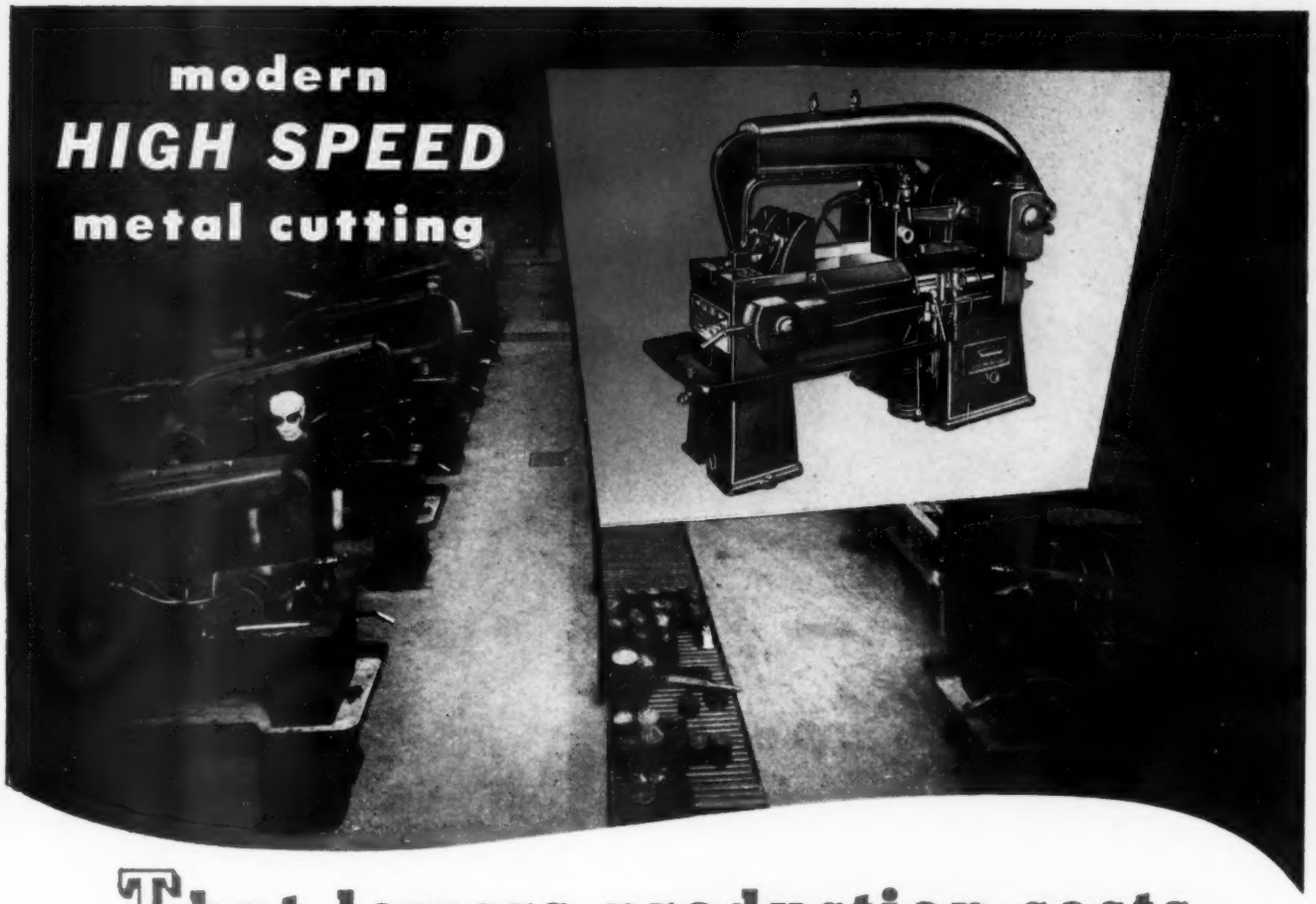
SPRINGFIELD GEARED HEAD LATHES



for peacetime or war production!

A lathe purchased now, for round-the-clock war production, must still meet peacetime requirements. Therefore, specify SPRINGFIELD lathes—flexible, efficient, ideal for emergency or normal production. SPRINGFIELD lathes are built in sizes from 14" to 30". Write for descriptive bulletins, prices, deliveries, etc.

The SPRINGFIELD MACHINE TOOL COMPANY • • • SPRINGFIELD, OHIO, U.S.A.



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Here is modern high speed metal cutting—with greatest efficiency —at the start of a great production line. This battery of Racine heavy duty Hydraulic metal cutting Machines in a prominent midwestern steel mill, is speeding up the plant capacity.

These smooth, powerful hydraulic Machines save time and material. Their accuracy reduces the cost of subsequent machining operations—all factors in helping you meet the post war need for maximum efficiency, increased output, lower costs.

A complete series of Machines from 6″ x 6″ to 20″ x 20″. Get our catalog No. 12. Also ask for Free production estimates on your specific work. Write today.

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Consider Racine *Variable Volume* Pumps and Racine Valves for your oil hydraulic circuits. Pump 0 to 30 G.P.M. Operating pressures 50 to 1000 lbs. p.s.i. Valves in all sizes from ⅜″ to 1½″ I.P.S. Full information in our catalog P-10-C. Write.

RACINE TOOL AND MACHINE CO., 1751 State St., Racine, Wis.

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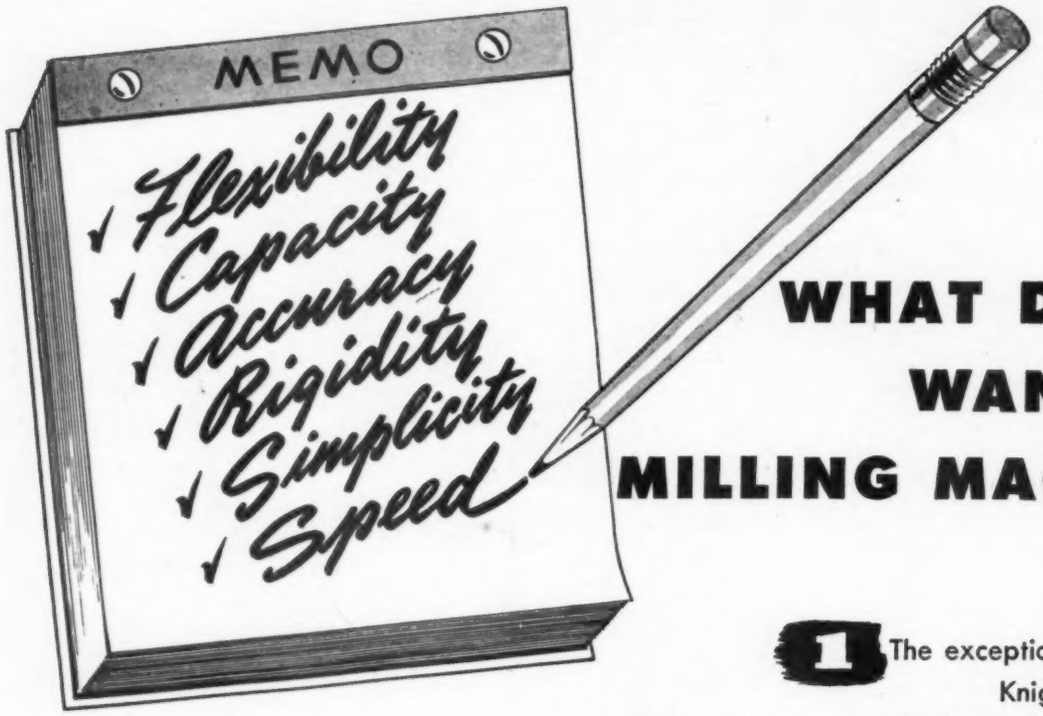
Standard for Quality and Precision



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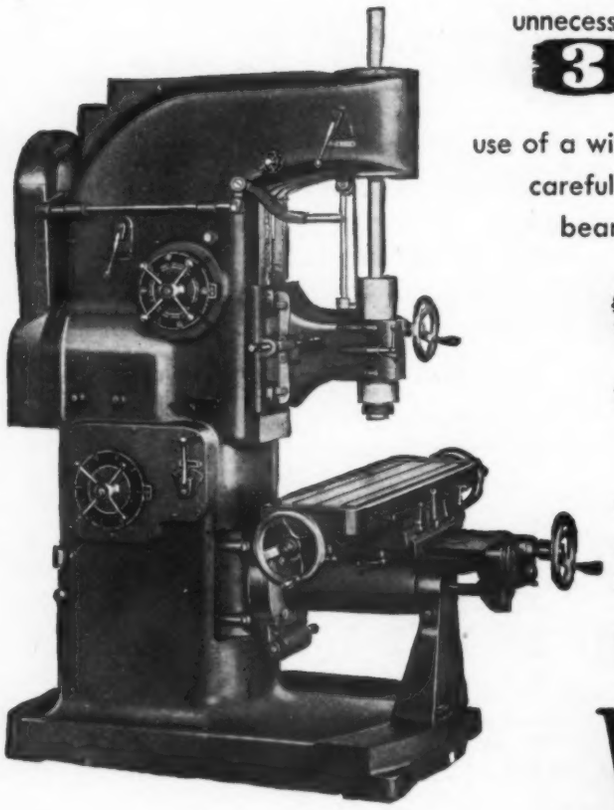
1 The exceptional adaptability of Knight Millers simplifies production of unusual or difficult jobs that often require two or more special machines... **2** Its tilting, swiveling table makes expensive special jigs, angle plates or other fixtures unnecessary for complicated milling, boring or shaping jobs... **3** Its sixteen table and spindle feed changes, and four different vertical spindle feeds, provide for the use of a wide range of various size cutters... **4** Its strong, carefully engineered one-piece column casting, wide accurate bearings, precision gearing and rigid supports promise accuracy, effortless operation and long service... **5** Its easy operating controls for direction, speeds and feeds, properly located for full vision and convenience, save time and boosts production.



Knight Millers combine ALL the benefits of versatility, accuracy, speed, simplicity and long service. Learn how they can help you increase output and lower costs.

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KNIGHT VERSATILE MILLERS ACCURATE RIGID

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TO HANDLE COMPLEX TOOL GRINDING JOBS

with maximum speed and convenience

use G&L's GRAND RAPIDS No.4

Universal Cutter and Tool Grinder

EXTREME FLEXIBILITY of the No. 4 Universal Cutter and Tool Grinder permits two ways of performing nearly every operation: 1. With the spindle head locked, the sleeve and knee swivel around the column; 2. With the sleeve locked the head swivels on the column.

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FORMED CUTTER GRINDING

SURFACE GRINDING

HOB GRINDING

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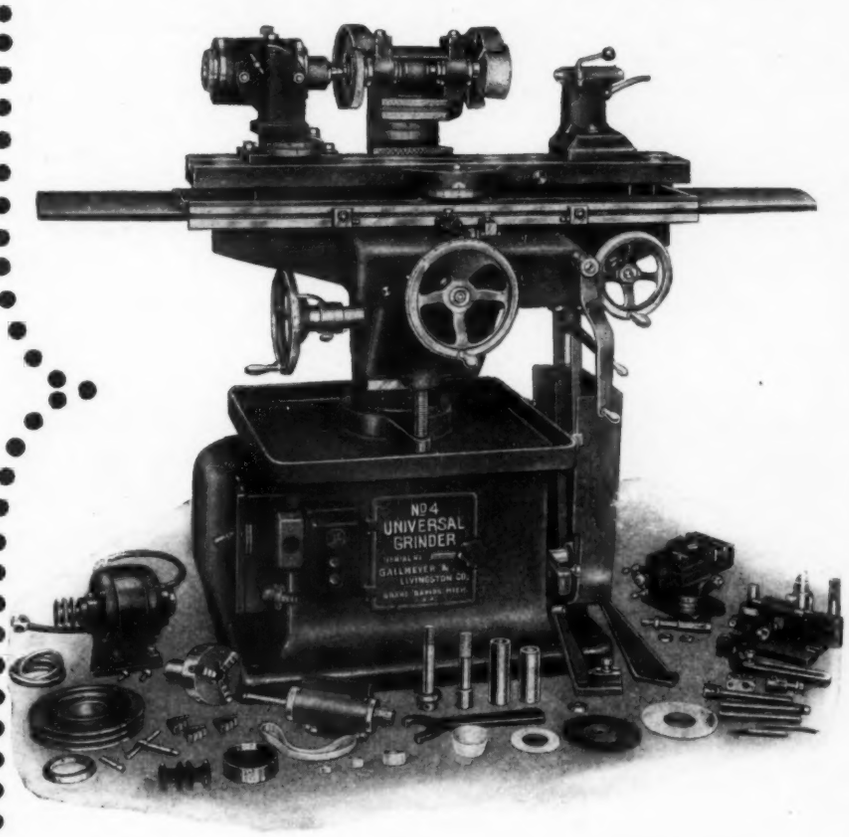

CONVENIENT OPERATION permits control of machine from either front or rear. Power feed providing 6 longitudinal table speeds and wet grinding are available.

What "GRAND RAPIDS" Quality Means: G & L cast their own close-grained gray iron, machine all parts to micrometric tolerances, and precision-assemble grinding machinery of unsurpassed performance. *Grand Rapids* means *top* quality in grinding machinery.

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WHEN MINUTES COUNT *WITH A* **COULTER HOB THREAD MILLER**

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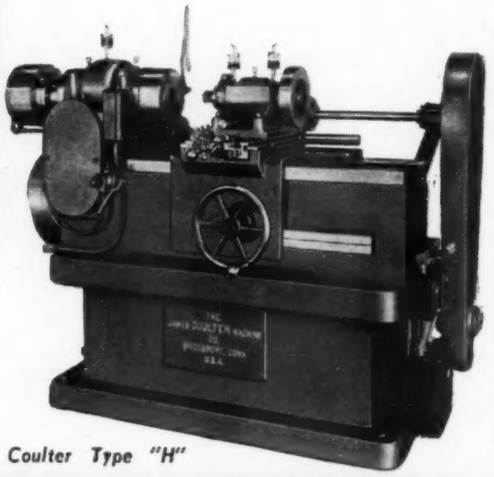
ACCURATE HOB THREADING is done with Precision and Speed on this RIGID . . . SIMPLE . . . FULLY MOTORIZED COULTER MACHINE.



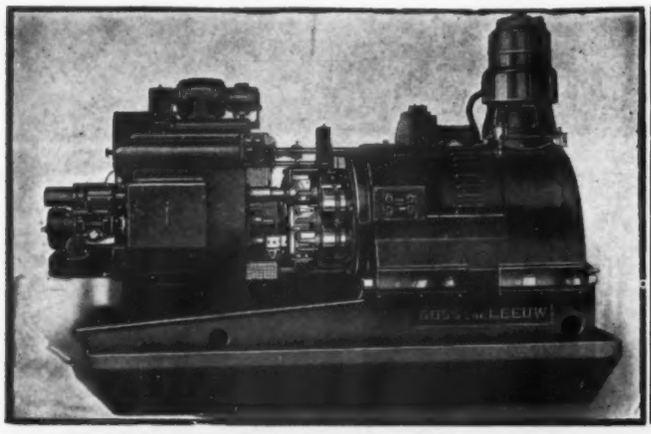
Coulter Type "H"

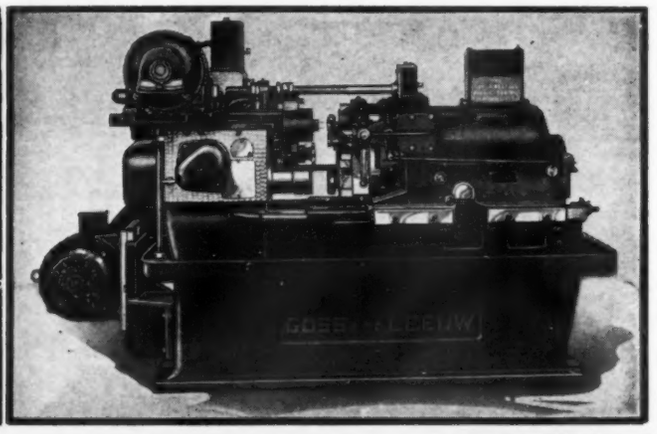
It has unlimited capabilities, with a maximum external thread of 7 inches; either for right or left hand threads, internal or external.

Any parts that can be held in ordinary chucks, air operated chucks, air operated collet chucks, or special face plate fixtures can be threaded on this COULTER TYPE "H".

The James COULTER Machine Co.

BRIDGEPORT • CONNECTICUT • U.S.A.





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TOOL ROTATING TYPE
4 Spindles
5 Chucking Positions

Features include:

Lead Screw Threading on both types—Preloaded Anti Friction Spindle Bearings—Hardened Ways—Oversize Spindles—Gears of Chrome-nickel steel, carefully heat-treated.

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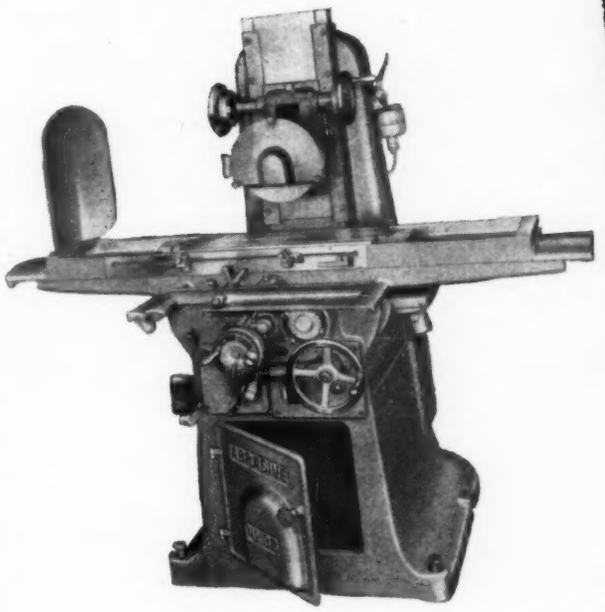
WORK ROTATING TYPE
5 Spindles
6 Spindles
8 Spindles

GOSS & DE LEEUW MACHINE CO., NEW BRITAIN, CONN.

ABRASIVE 3-B SURFACE GRINDER



This modern, automatic feed surface grinder has ample work ability to meet the heavy production schedules of competitive manufacturing. Its smooth action and perfect control count today where exceptional accuracy, fine finish and high production are essential. Write for Bulletin.

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ACCURACY BOOSTS PRODUCTION

ABRASIVE MACHINE TOOL CO.
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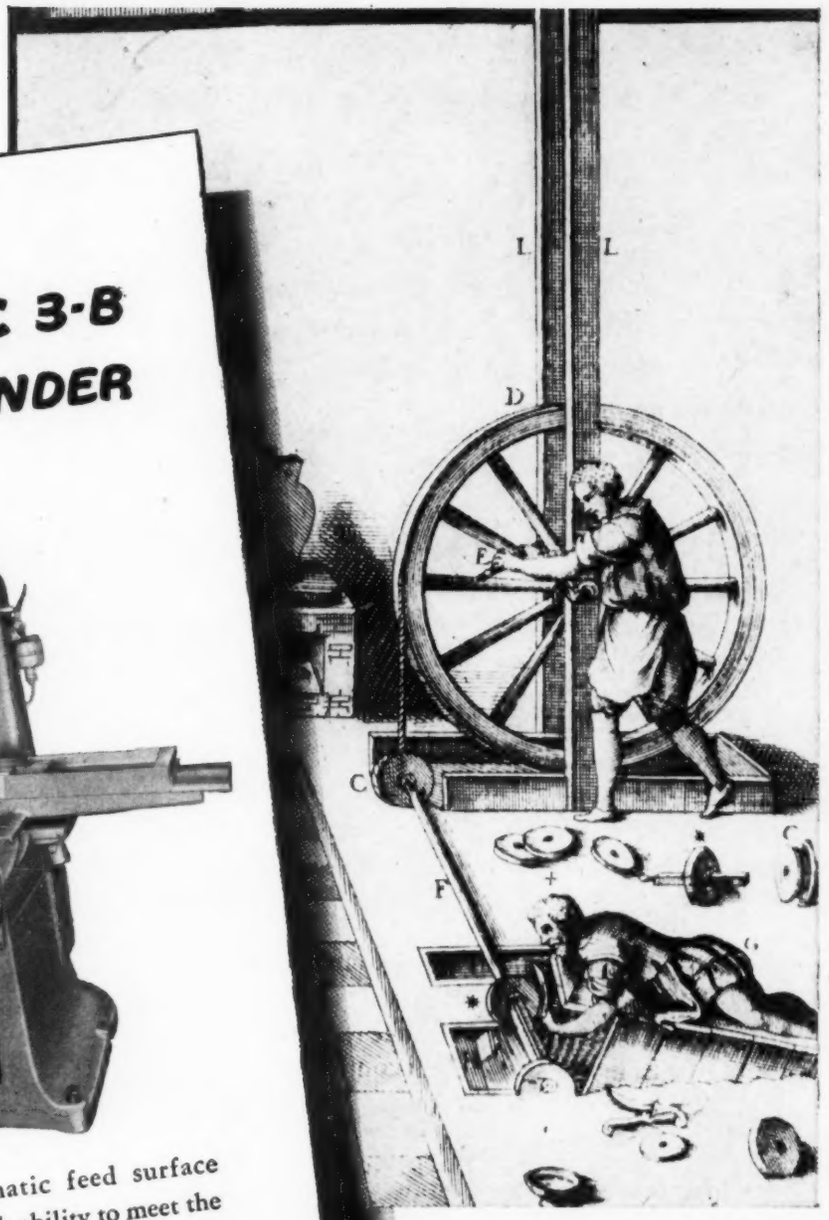

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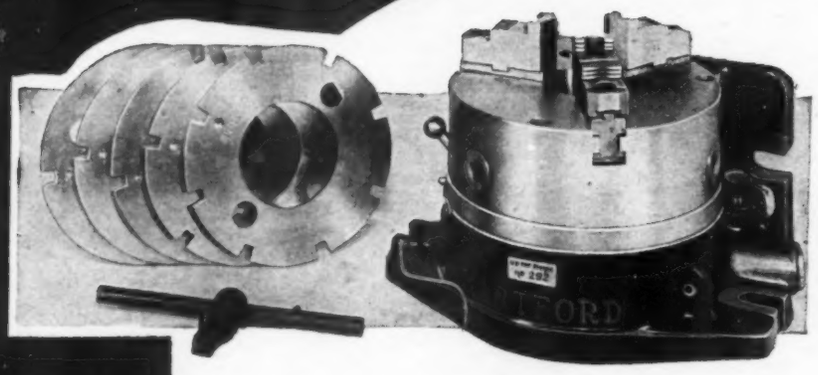
LYING DOWN ON THE JOB THREE CENTURIES AGO

It was really a grind to produce knives and tools in this 17th century shop. The comfort of the machine operator was of no consequence and production was a creaking, time-consuming process.

The Government Machine Tool Surplus Lists may include ABRASIVE Machines to replace your obsolete machinery. Send us the machine serial number for any desired information; we will endeavor to provide attachments, accessories and repair parts as required.



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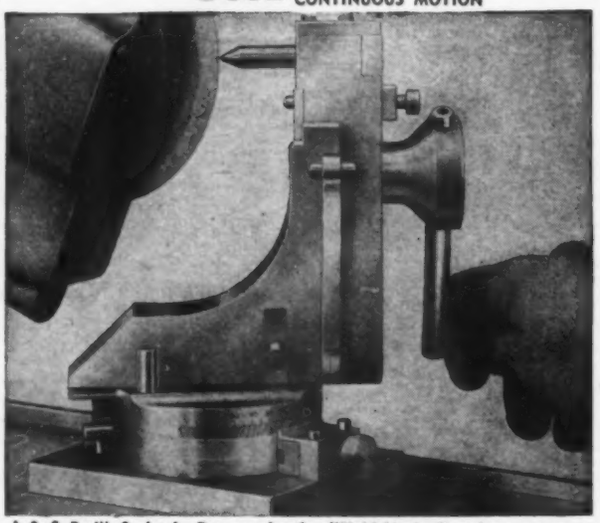
Fluid-motion

for modern form-dressing

ONE SETTING HANDLE CONTINUOUS MOTION



J & S Radii & Angle Dressers in the "Fluid-Motion" series are among the finest precision dressing instruments procurable. . . . regardless of cost. There is a standard model to fit most form-dressing requirements.

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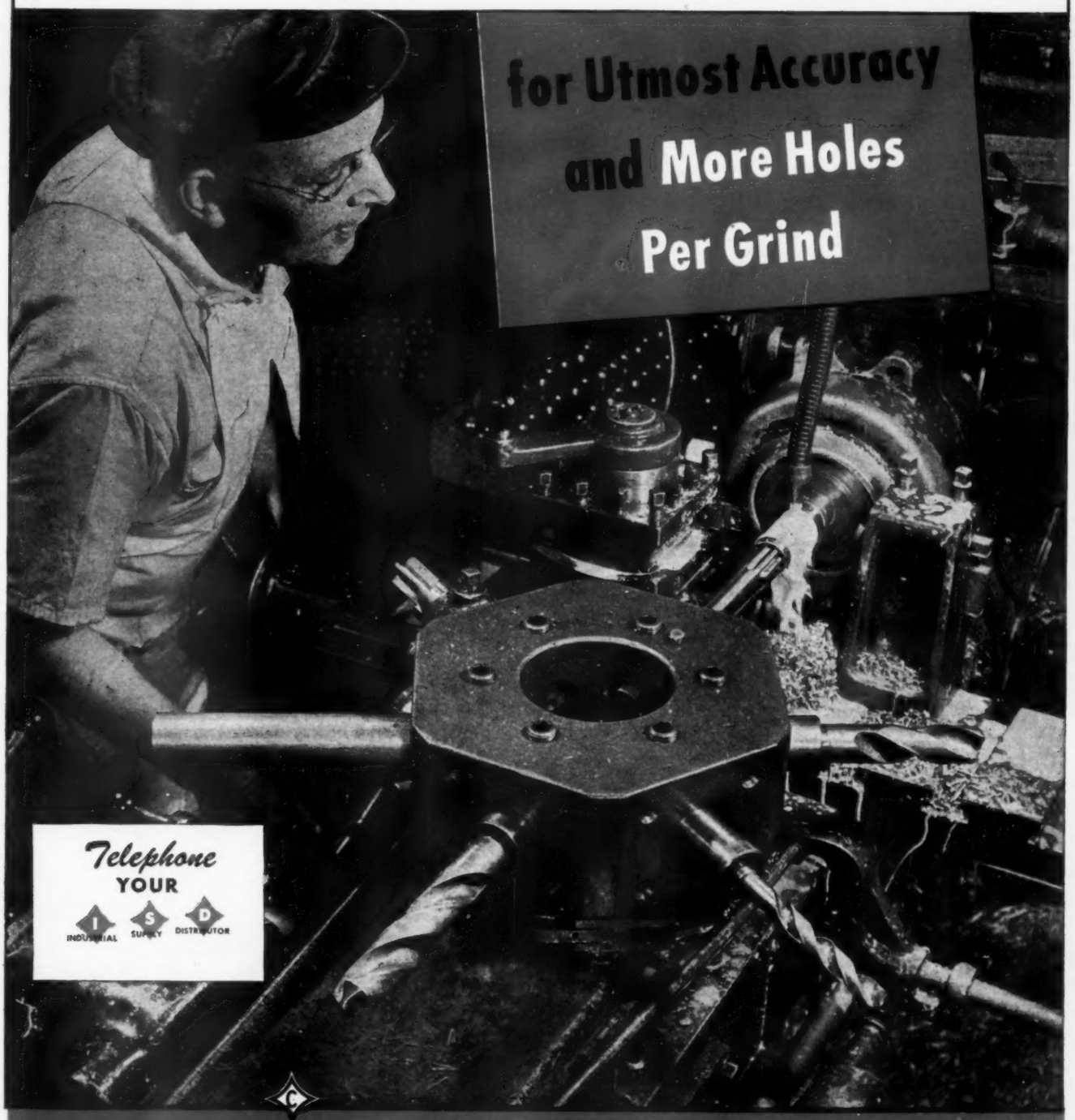

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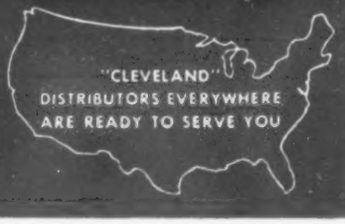

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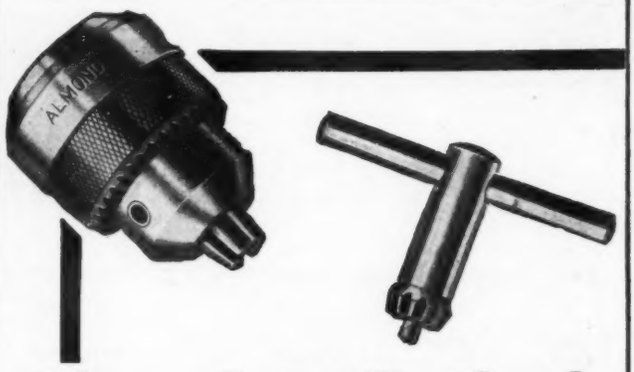

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THE FIRST IN THE FIELD

ALMOND THREE-JAW DRILL CHUCKS were the first to be placed on the market over Seventy years ago. As Pioneers in the field of Drill Chucks, the name "ALMOND" has long been associated with the logical procedure of machine developments. ALMOND DRILL CHUCKS are made in types and sizes to fit all machine tools and portable drills.

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The Original Manufacturers of Drill Chucks

T. R. ALMOND MFG. CO.
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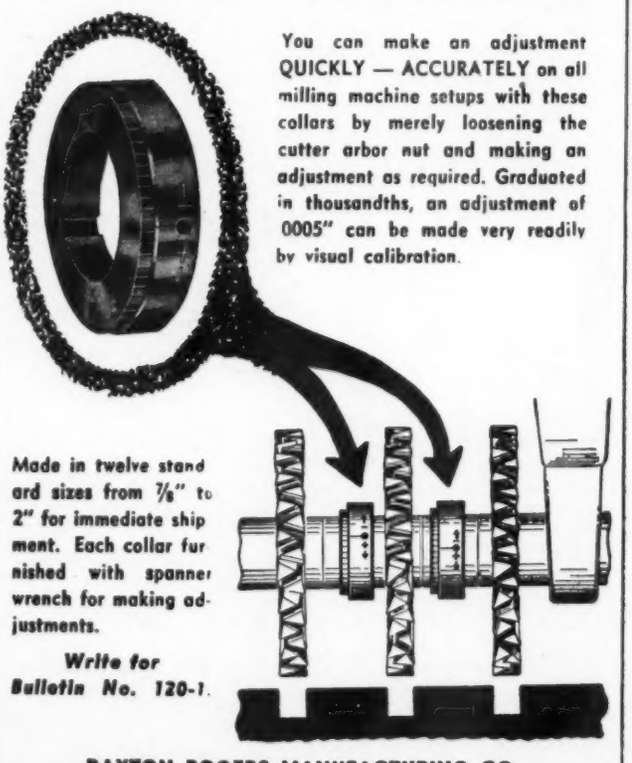
on side milling cutters and gang milling setups with Dayton Rogers Micrometer Adjustable Spacing Collars



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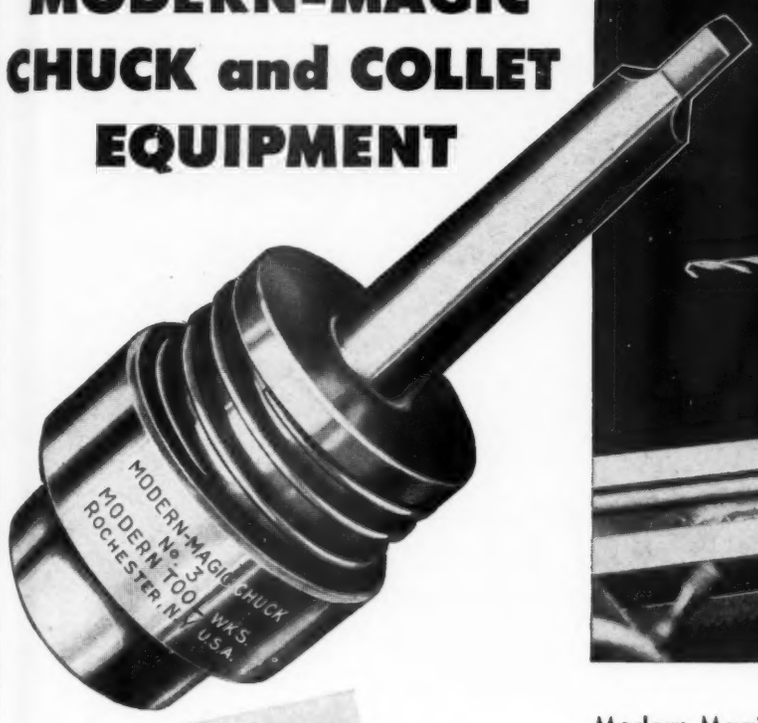
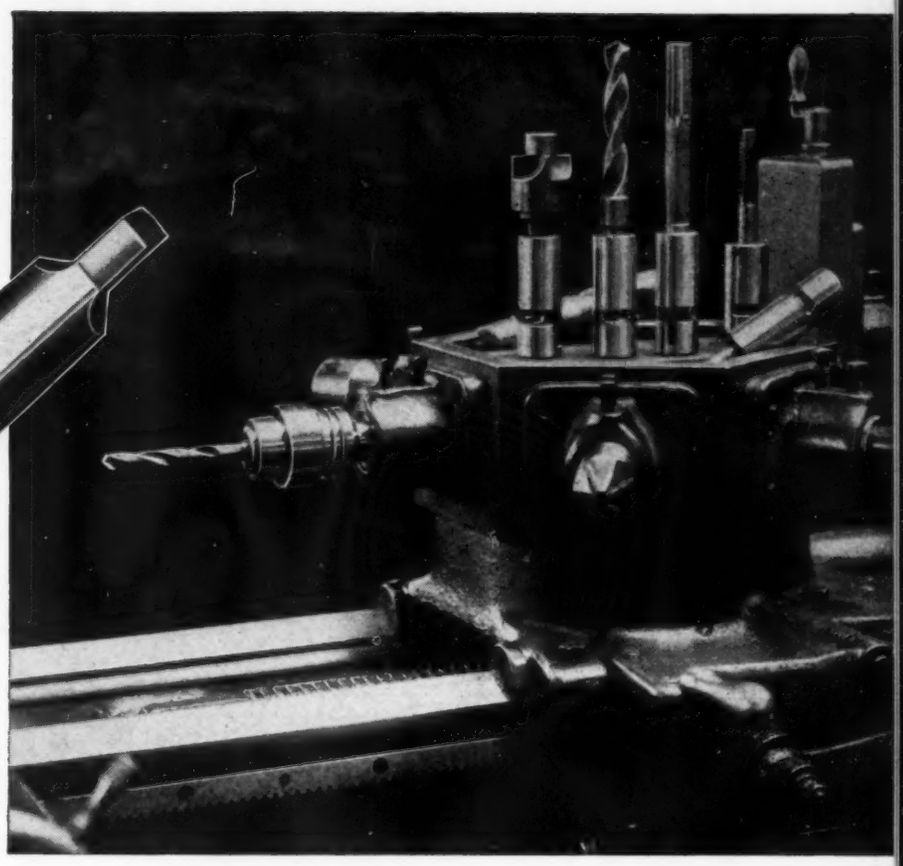
Make them available with

MODERN-MAGIC CHUCK and COLLET EQUIPMENT





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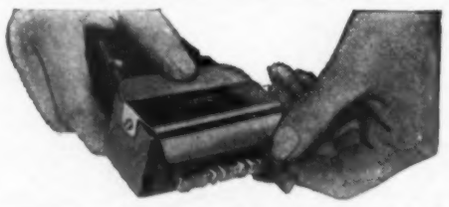

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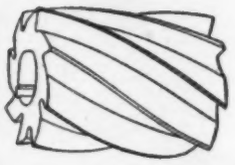

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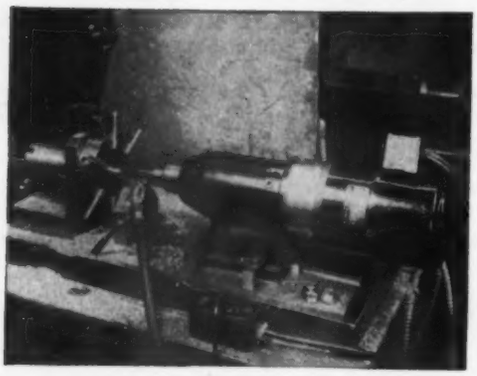

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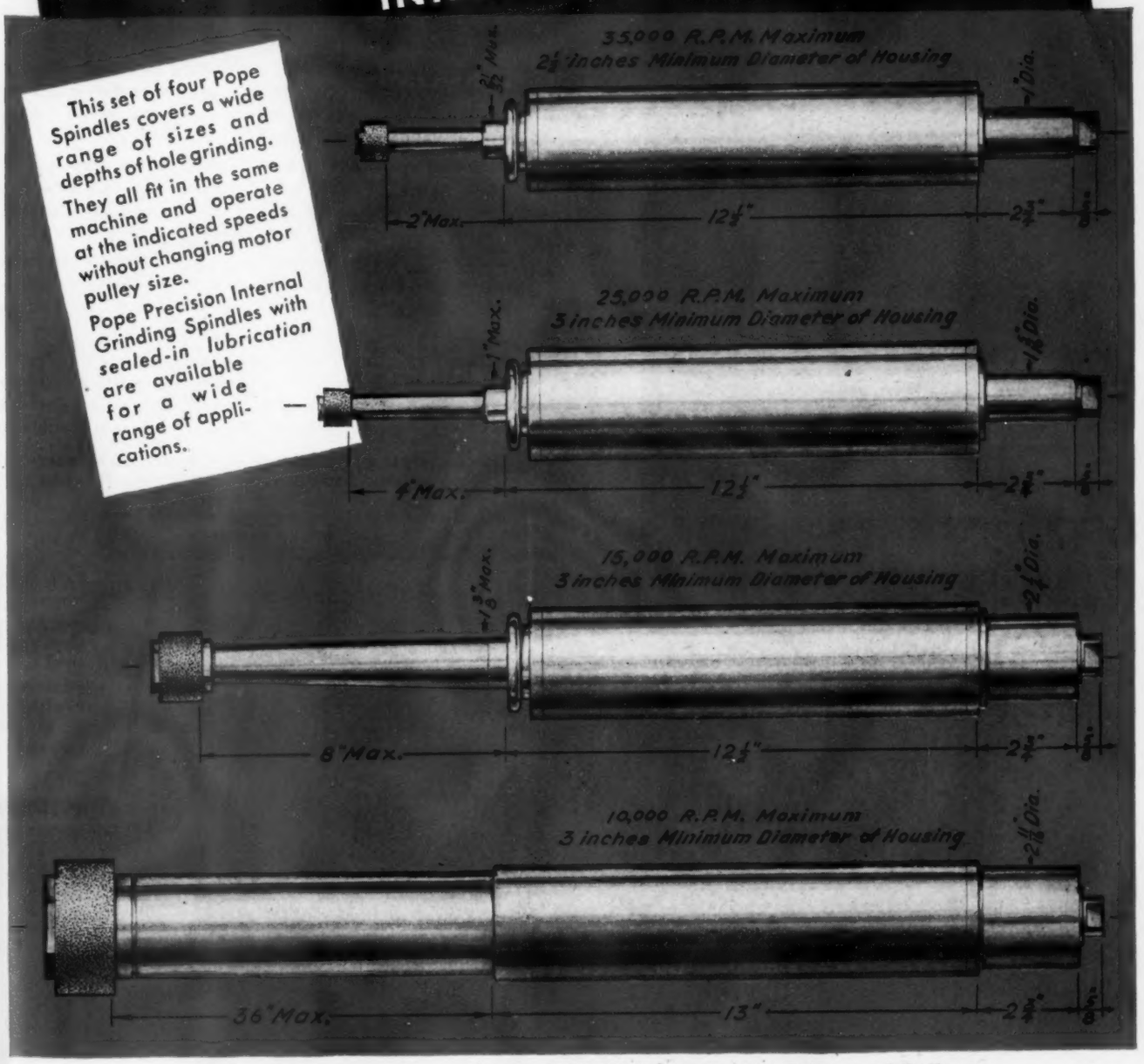

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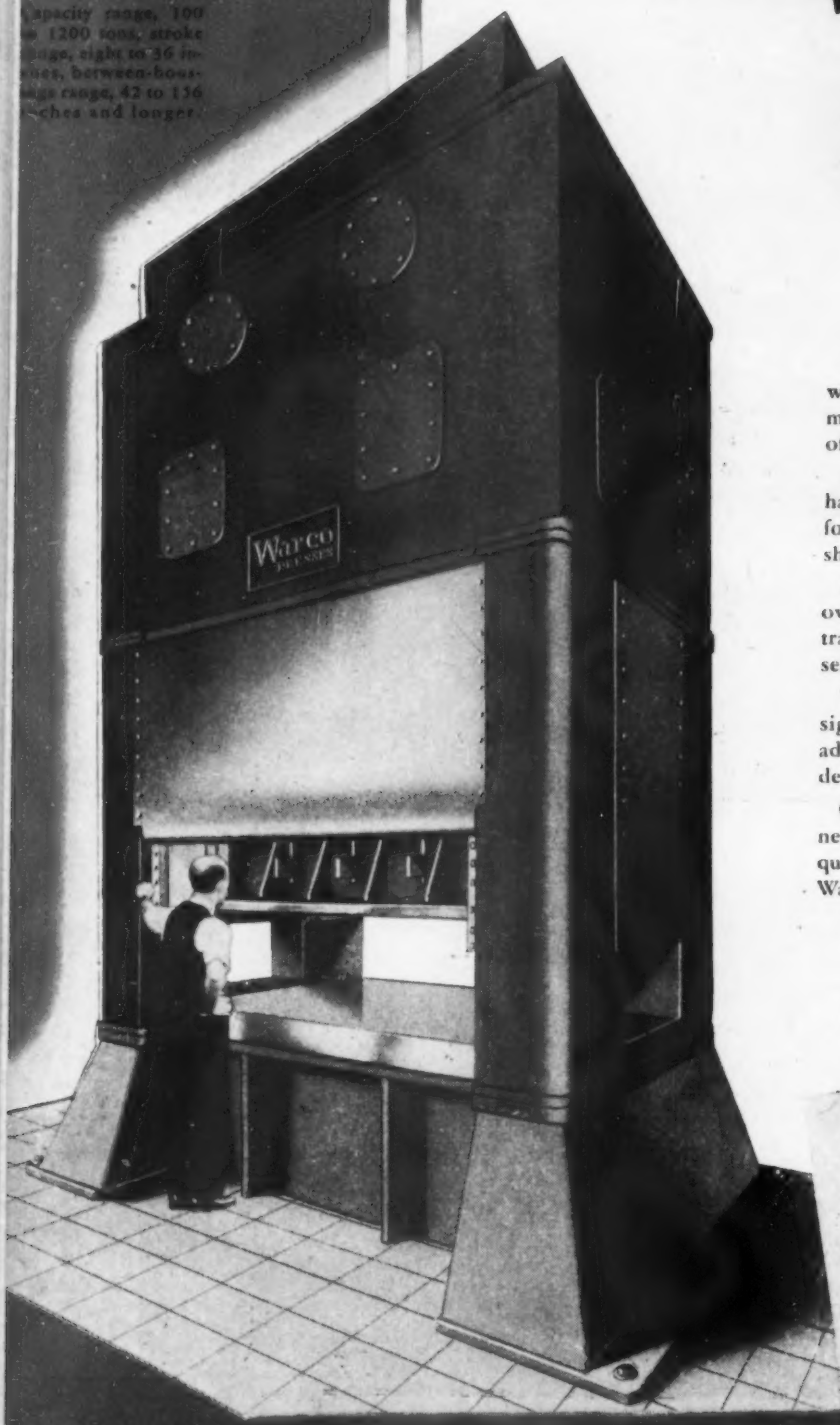
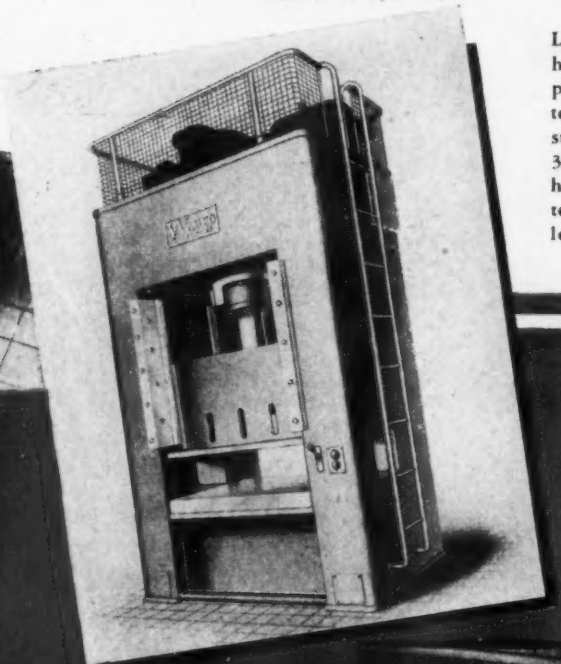
Capacity range, 100 to 1200 tons, stroke range, eight to 36 inches, between-housings range, 42 to 156 inches and longer.



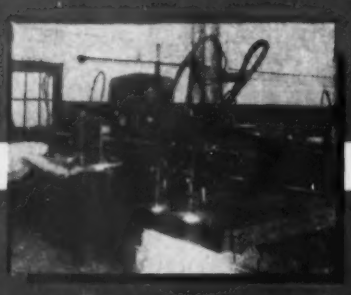


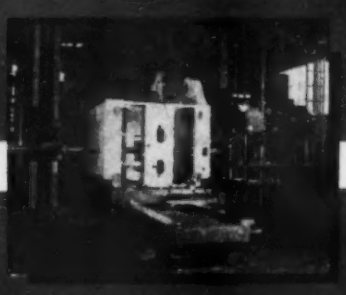
Left, straight-side ove, press b hydraulic press, c acity range, pacity range 10 500 tons, to tons to 1200 ton lengths up stroke range 10 t et and lon 30 inches. Betwee ght, double-c housings range, 3 press, cap to 156 inches a ge, 100 to longer. s.

WARCO'S UNSURPASSED PRODUCTION FACILITIES ARE AT YOUR SERVICE

The home of Warco presses at Warren, Ohio, is one of the largest, most modern and completely equipped factories of its kind in the world. Built in 1942, it contains over 250,000 square feet of floor space for production and has the latest type machinery for plate preparation, welding, machining and final assembly of the heaviest equipment.

The series of photos at the bottom of the page shows part of these facilities which enable Warco to produce the finest in all-steel welded presses and to render prompt satisfactory service to customers.





A Complete Line of

ALL-STEEL WELDED

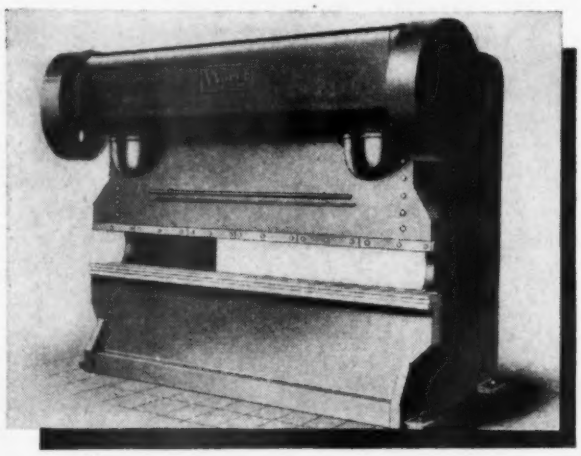
★ Open Back Inclinable Models
★ Two-Point Eccentric-Gear Models
★ *Straight-Sided Hydraulic Models*
★ Mechanical Press Brakes

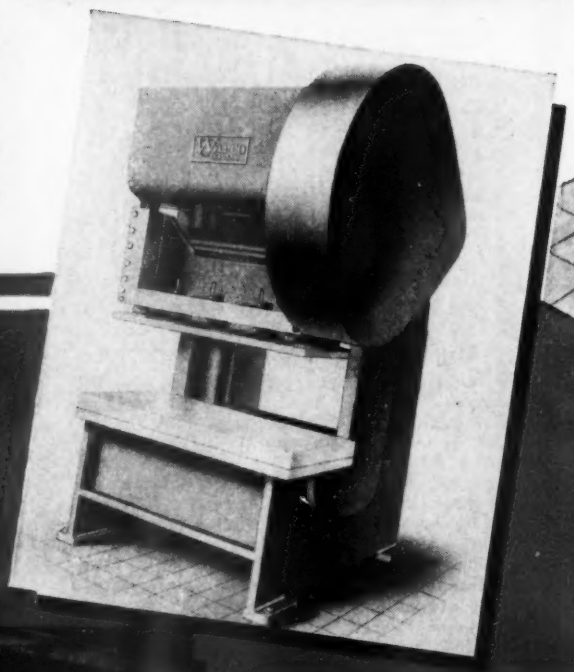
All weldments are *fully stress-relieved* to provide maximum

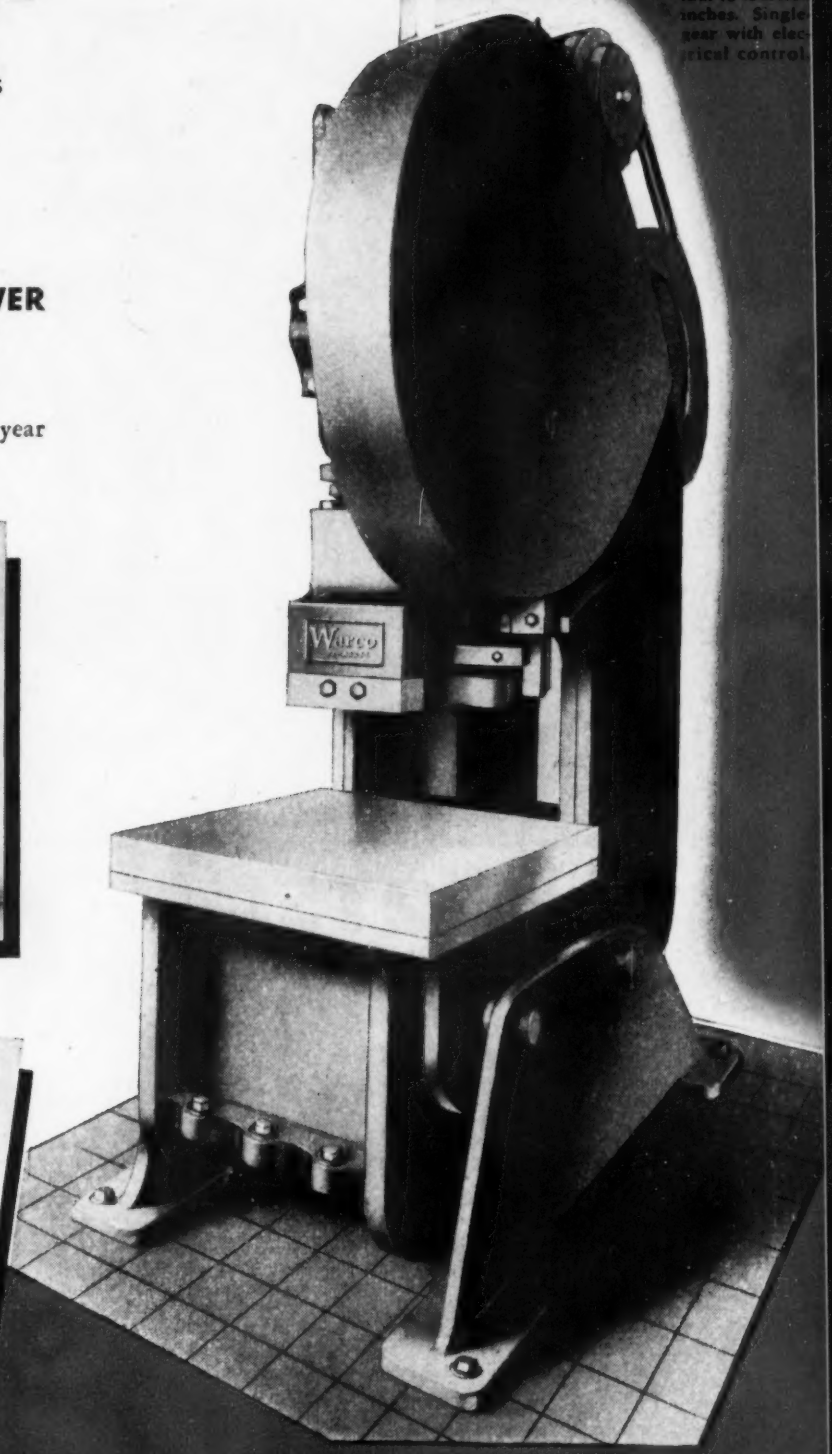
★ RIGIDITY ★ STRENGTH ★ POWER
★ ENDURANCE ★ ACCURACY

WARRANTY GUARANTEE

Warco presses are unconditionally guaranteed for one year against defective material or faulty workmanship.







OPEN BACK INCLINABLE MODE

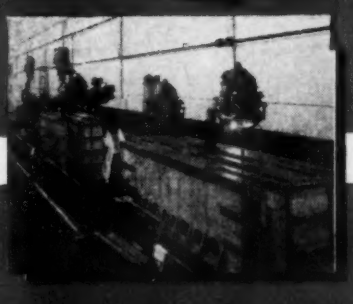
Capacity range 50 to 150 tons, stroke range four to fourteen inches. Single gear with electrical control.

ove, press brake, acity range, 100 500 tons, to han- lengths up to 24 t and longer.

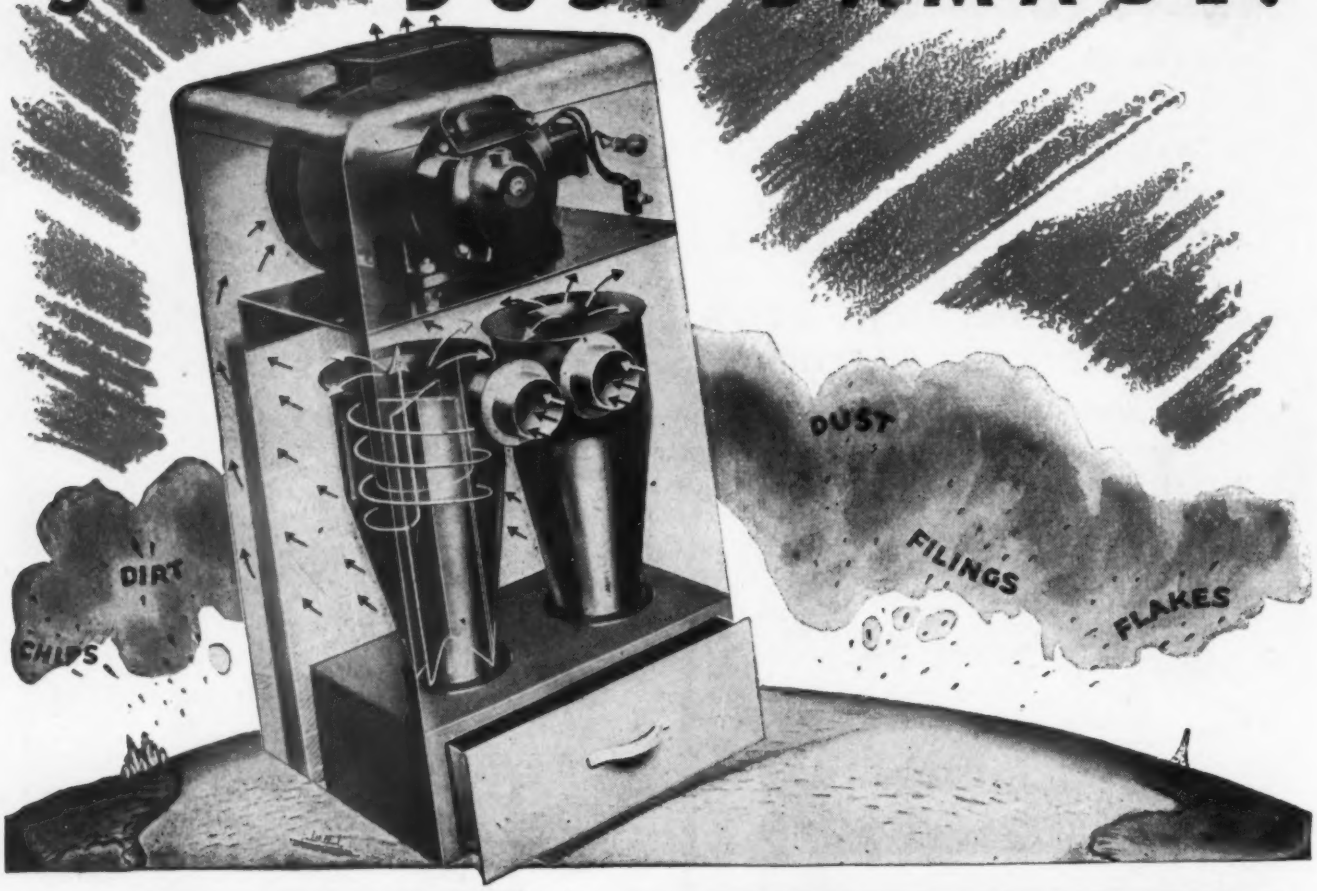
ght, double-crank press, capacity ge, 100 to 500 s.

POLICY ON DELIVERIES

Unusually large production facilities lessen the delivery problem with us. We are in position to give prompt attention to your order or inquiry. For information as to the delivery of the press you need, we invite you to consult us today.



STOP DUST DAMAGE!



PROTECT

Health and Promote Safety

with IDEAL DUST COLLECTOR

Easily installed on any machine
Inexpensive . . . Powerful . . . Twin Cyclone Separators

Powerful suction removes dust and abrasive particles from grinding, buffing and other machining operations. Safeguards workers' health. Air passes through twin cyclone separators and a filter, assuring thorough cleaning.

Portable. Easy to install. Compact. No need to relocate machinery. Accessories available to fit various machines.

This development is typical of IDEAL's quarter-century-old policy of constantly making new and better things. IDEAL now has 100 products supplied by more than 200 IDEAL Service Engineers through warehouses and wholesalers in principal industrial centers, serving IDEAL's 40,000 Customers.

715 **PROMPT DELIVERY**

Machinery Products Division
IDEAL INDUSTRIES, Inc.
(Successor to Ideal Commutator Dresser Co.)
1911 PARK AVENUE SYCAMORE, ILLINOIS

Helping MACHINERY Serve America Better

NEW IDEAL Lathe CHUCKS

Independent and Universal Types

- Easily adaptable to any lathe.
- Jaws hardened and ground. 2-sets—Internal and External Type.
- Cast Adapter witheachChuck.
- LOW COST—High Precision.

IDEAL ELECTRIC TACHOMETER

Designed for measurement of shaft and belt speeds. Can be used as "hand type" or "separable type." Two ranges—0- to 2500 RPM. and 0- to 5000 RPM.

IDEAL LIVE CENTERS

Handle heavier loads . . . permit deeper cuts at higher speeds, because they rotate *with* the work. Special bearing construction assures accurate turning for precision jobs. Four interchangeable inserts for all centered and uncentered work.

Send for FREE 88-page HANDBOOK describing IDEAL'S many new and better products and methods.

RED
"NOT GO"
Pat. Pending

GREEN
"GO"

NOW! GAGE LIFE 12½ TIMES LONGER

...SERVICE RECORDS SHOW

5-PLUS FEATURES

1. Greater accuracy and stability
2. Longer wear life
3. Less weight
4. Positive identification
5. Positive adjustment

ACCURACY YOU CAN TRUST

WOODWORTH THREAD RING GAGE PROVES AMAZING SUPREMACY OVER ORDINARY GAGES

Almost unbelievable results on actual shop inspection prove the new Woodworth Adjustable Thread Ring Gage far superior to ring gages of ordinary design.

ONE MANUFACTURER, USER OF MANY GAGES, MAINTAINED ACCURATE INSPECTION WITH A SINGLE WOODWORTH GAGE TWELVE AND ONE-HALF TIMES LONGER THAN WITH ANY RING GAGE PREVIOUSLY USED. THINK WHAT THIS MEANS TO YOUR GAGE COSTS.

Wire or write for folder No. 46R.

WOODWORTH

N. A. WOODWORTH CO., SALES DIVISION, 1300 E. NINE MILE ROAD • DETROIT 20, MICHIGAN

PRECISION GAGES • PRECISION MACHINE PARTS • DIAPHRAGM CHUCKS • ADJUSTABLE CLAMPING JIGS • SPECIAL TOOLS

It's New! It tells all about Cal-Cutter carboloy-tipped tools!

• For easy ordering, for accurate data, this new Cal-Cutter catalog covers all information to enable you to select the correct cutter for the job to be done. Data is clearly and concisely outlined for easy reference. The tool, catalog number, prices, diameters, number of tips, thickness, diameter of bore, size of tip in inches, tip chamfer, recommended speeds, feeds and other data are easily found in this new catalog.

Get Your Copy Now! With it we will send the name and address of the Cal-Cutter distributor nearest you.

"Tool life increased 35% when we switched to Tycol #675"

Chips no longer weld to tools . . .
Tool regrindings reduced . . .
Gum deposits eliminated . . .
No more trouble with rust . . .

These are a few advantages of Tycol #675 Heavy Duty Cutting Oil observed at one large plant. You, too, will find that Tycol #675's demonstrated superiority will help you increase production . . . cut costs . . . produce finer, tarnish-free finishes.

For complete data about Tycol #675 Heavy Duty Cutting Oil, phone your nearest Tide Water Associated Office.

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C.
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TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N. Y.

LUBRICATION—"ENGINEERED TO FIT THE JOB"

PREVENT CONTAMINATION – EXTEND TOOL LIFE

with the NEW BARRETT COMBINATION STERILIZER AND SEDIMENTOR for CUTTING OILS . . . .

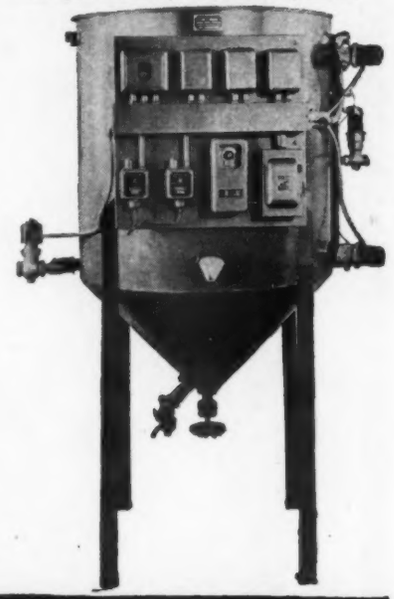
Protects your operators against infection—insures more and better work from your cutting tools—by sterilizing your cutting oils and precipitating sediment *at the same time.*

The NEW BARRETT STERILIZER AND PRECIPITATOR combines these two operations in one piece of apparatus which can be depended on to handle both operations effectively, efficiently and economically. Sterilization is by heat and is a positive active operation in the line ahead of the supply tank. By locating in this position, contamination is intercepted before the cutting oil is conditioned for safe, bacteria-free reuse.

Because of the heat to which the oil is subjected during sterilization, the viscosity of the cutting oil is reduced, thereby encouraging precipitation of minute heavy particles. The sediment thus liberated settles out and drops by gravity to the bottom of the sterilizer where provision is made to scrape the precipitated solids from the conical bottom and clean them out.

By thoroughly and constantly sterilizing and effectively removing solid matter, the Barrett Combination Sterilizer and Sedimentor reconditions cutting oil for reuse; sterilized for safety's sake and abrasive-free for longer tool life.

Barrett Sterilizer and Sediment Precipitator arranged for fully automatic operation.



GET COMPLETE INFORMATION NOW

These units are available for floor, wall and post mounting and are furnished with semi-automatic or full automatic control as required. Send at once for detailed information on this timely Barrett development.

THE LEON J. BARRETT CO., WORCESTER, MASS.

Designers and Builders of Centrifugal Machinery

GREEN MASTER FEED FINGERS

FOR AUTOMATIC SCREW MACHINES

CUTAWAY VIEW SHOWING SYNTHETIC INSERT

DO NOT SCRATCH

The *synthetic rubber insert*, distinguishing feature of GREEN Master Feed Fingers, will not cause any scratches or other disfiguring and scrap-making marks to appear on even the softest stock. *Check NOW* on this and many other distinctive, time-saving, money-saving features of GREEN Master Feed Fingers!

GREEN MANUFACTURING CO.

650 S. WYMAN ST., ROCKFORD, ILLINOIS

INTERCHANGEABILITY

Your KEY to MASS PRODUCTION
Will Speed up Drilling and Lower Costs

A. S. A. STANDARD PRECISION DRILL JIG BUSHINGS

Standard sizes and styles in stock for prompt delivery. Write for catalog showing table of standard sizes of bushings with price list and other valuable information for the tool designer.

REPRESENTATIVES

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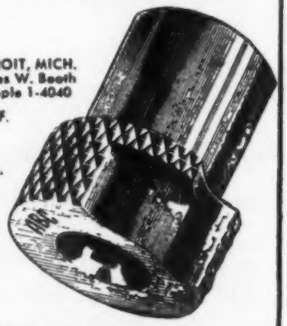
SEATTLE, WASH. — H. F. Soderling Co. — GArfield 8386
• STRATFORD, CONN. — Ellsworth St. & Sup. Co. — BRidgeport 7-3317
TOLEDO, O. — J. W. Mull, Jr. — GArfield 8017



*Stock carried at these locations

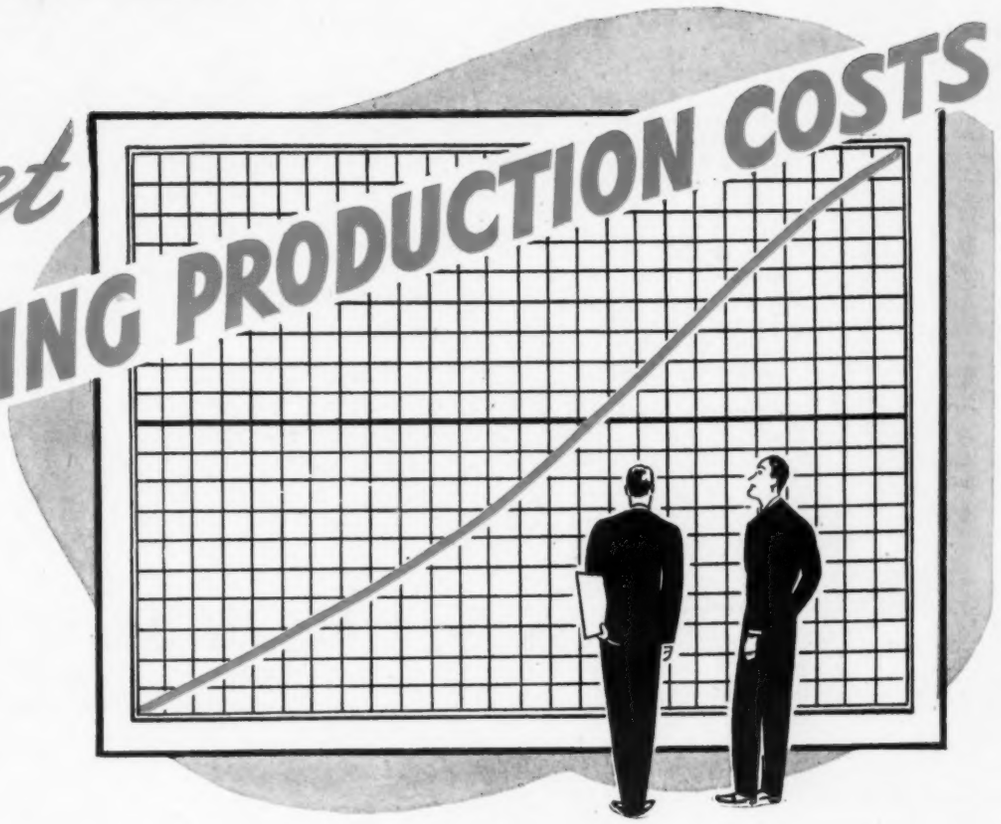
ACCURATE BUSHING CO.

440 North Ave., Garwood, N. J. • WEstfield 2-2415

USE RUBBER-CUSHIONED

Brightboy

Offset MOUNTING PRODUCTION COSTS



TODAY, with material and labor costs mounting, production economies are doubly appreciated. You can achieve production economies with rubber cushioned Brightboy, which has demonstrated work-time savings thru simultaneous, one-operation BURRING, FINISHING and POLISHING . . . by bridging the gap between the grind and the buff. Made in three textures—Fine-Tex, Standard and Tuff-Tex—for wide work-adaptability in manual and machine applications.

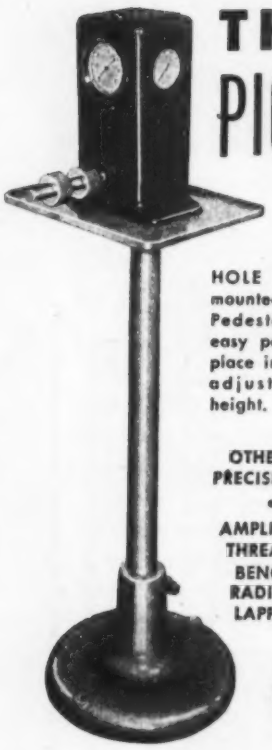
Ask your dealer for the new Brightboy catalog, prices, and applications-data; ask the Brightboy service man for production short-cut suggestions.

BRIGHTBOY INDUSTRIAL DIVISION
Weldon Roberts Rubber Co. Newark 7, N. J.

WELDON ROBERTS
Brightboy

THE AMERICAN HOLE CHECKER

PIONEER of Air-Operated Gages . . . Maintains Lead for Accuracy . . . Does Not Vary

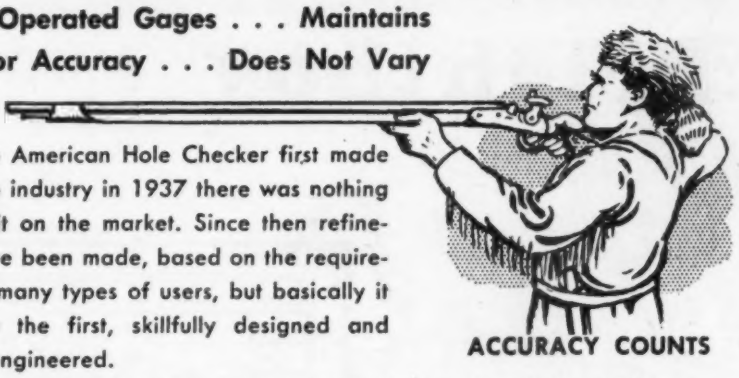


HOLE CHECKER UNIT mounted on Space-Saver Pedestal accessory for easy positioning at any place in shop and quick adjustment to right height.

OTHER AMERICAN PRECISION PRODUCTS

• • •

AMPLIFYING GAGES
THREAD CHECKERS
BENCH CENTERS
RADIUS DRESSERS
LAPPING PLATES



ACCURACY COUNTS

When the American Hole Checker first made its bow to industry in 1937 there was nothing else like it on the market. Since then refinements have been made, based on the requirements of many types of users, but basically it was from the first, skillfully designed and soundly engineered.

So the air-operated unit you get today is time-tried and dependable for I. D. checking. With an O. D. accessory unit, it may also be used for outside diameter checking.

The Hole Checker is the ideal gage for both production and inspection. It is quickly set up—easily read—and it does not vary. Accuracy to .0001". The standard Hole Checker unit is used with one special sizing plug for each hole checked. Unit is set for gaging parts by means of two master ring gages.

Send parts prints for quotation. Write for new catalog and prices.

The AMERICAN GAGE & MFG. CO.
125 Bayard St. DAYTON 1, OHIO

This Noblewest Dial Feed Rapid Precision Marking Machine, tooled for marking, and knurling socket wrench parts, does the two jobs in one operation — at a speed up to 100 parts per minute. Equipped with the Noblewest pneumatic pressure compensator which assures uniform depth of impression, it is typical of the great advancement that represents Noblewest Modern Marking Methods. For faster, better, marking of your product at lower cost, write Noble & Westbrook Manufacturing Co., East Hartford 8, Conn.

MARK IT BEST WITH

NOBLEWEST

Hi-Speed Marking Machines

WEIGHT MUST BE MOVED
AND ECONOMY DICTATES
PORTELVATOR

You'll find a thousand jobs for Portelvator, the rugged portable elevating table with ease of operation and stability built-in. • Use as a level under overhanging work, to raise or lower heavy dies and castings to machine height, to fetch and carry, to load and unload, to charge and discharge heat treating furnaces, as a tough and willing helper to every man in your shop. • Made in three standard models with carrying capacities ranging from 1,000 to 5,000 pounds. Special models built to meet "out-size" specifications. • Equip your shop with Portelvator and watch your production mount. Write for literature and prices . . . Address Department D-P.

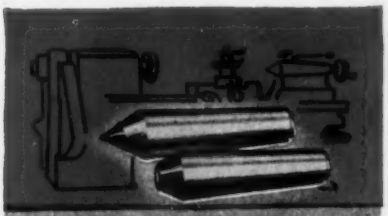
THE *Hamilton* TOOL COMPANY

SUPER SENSITIVE DRILLING MACHINES · TAPPING MACHINES · PORTELVATORS

NINTH STREET AT HANOVER · HAMILTON · OHIO · U·S·A

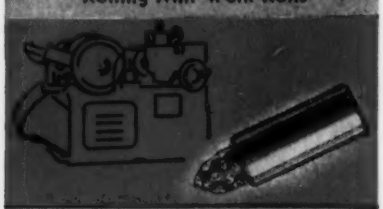
TALIDE METAL MEETS EVERY REQUIREMENT

Talide
(TUNGSTEN CARBIDE)
Performance!

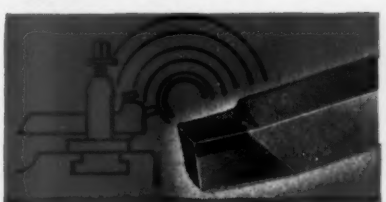

Lathe and Grinder Centers

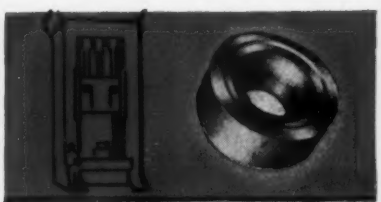
Centerless Blades

Rolling Mill Work Rolls


Diamond Wheel Dressers

A FEW MAJOR USES FOR TALIDE METAL


Cutting Tools


Sheet Metal Dies

Drill Jig Bushings

the hardest metal made!

Plug and Ring Gages

Wire and Tube Drawing Dies

Hardest man-made metal.
Highest modulus of elasticity. (double that of steel)
Extreme Density.
Low coefficient of expansion and contraction.
High compressive strength.
High red hardness.

On any cutting, drawing, or wear resistance application, you can increase production many times and cut costs as much as half. Cutting tools of Talide cut 2 to 3 times faster than high speed tool steel. Talide drawing dies and wear resistance parts usually outwear steel by at least 50 to 1.

Send us parts or prints and we will show you how this hardest man-made metal can improve your production. If you prefer, a Talide sales engineer will call at your office.

THE ENGINEERED CARBIDE FOR ALL APPLICATIONS

METAL CARBIDES CORPORATION

YOUNGSTOWN 5, OHIO *Pioneers in Tungsten Carbide Metallurgy*

SINTERED CARBIDES FOR CUTTING • HOT PRESSED CARBIDES FOR DRAWING AND WEAR RESISTANCE

THE DEMPSTER DUMPSTER TYPE "ARLF"

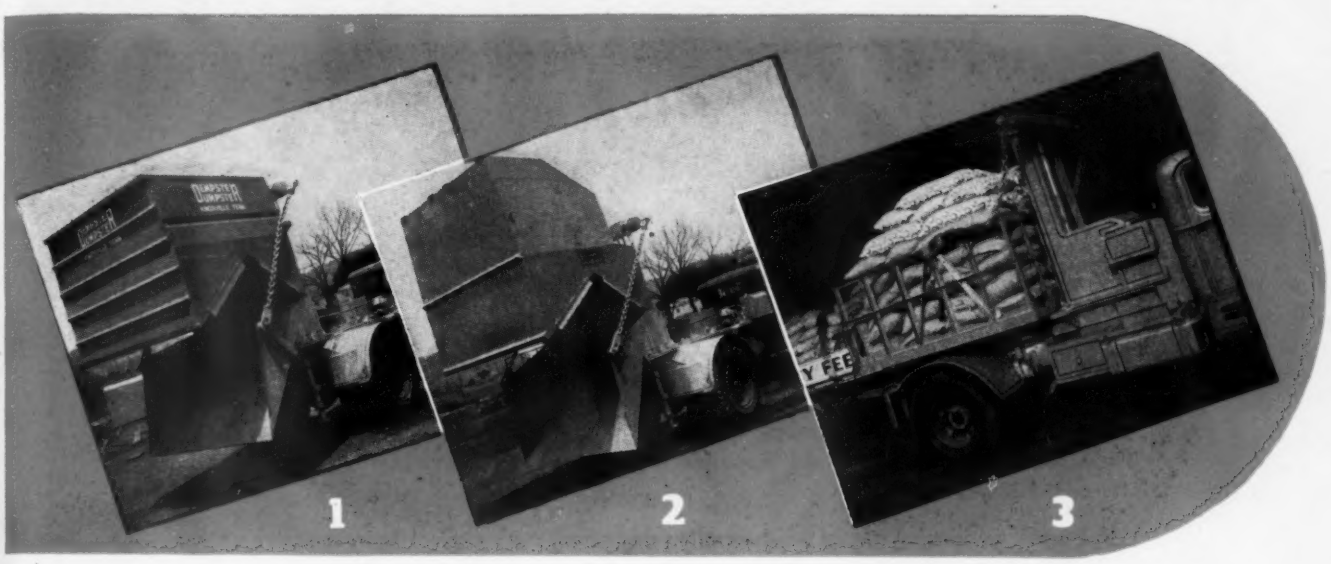
TREMENDOUS LOADS HOISTED BODILY TO HAULING POSITION. COMPLETE LOAD SET OFF OR DUMPED, HYDRAULICALLY, AT DESTINATION.

Here is new, heavy duty, materials handling equipment of major importance to industry. Its obvious possibilities in reducing costs of materials handling by truck makes it a paramount consideration for many firms.

The large photo above serves to indicate the size of large capacity, detachable bodies used with the Dempster-Dumpster Type "ARLF."

Photos at left; Top; you see the "ARLF" unit ready to pick up loaded body. Center; complete load has been raised and is ready for placing in carrying position. Note Automatic, self-aligning, hydraulic stabilizers at rear of unit. Bottom left; you see loaded body in hauling position ready for travel. Directly below; photo shows the "ARLF" dumping load instantly. Complete load, of course, may be placed on ground or platform, bodily, if preferred.

IT HOISTS 5 TO 10 TON LOADS FROM GROUND LEVEL TO HAULING POSITION IN 60 SECONDS



The Dempster-Dumpster Type "ARLF" is a new and important development in the Dempster-Dumpster System of materials handling for industry.

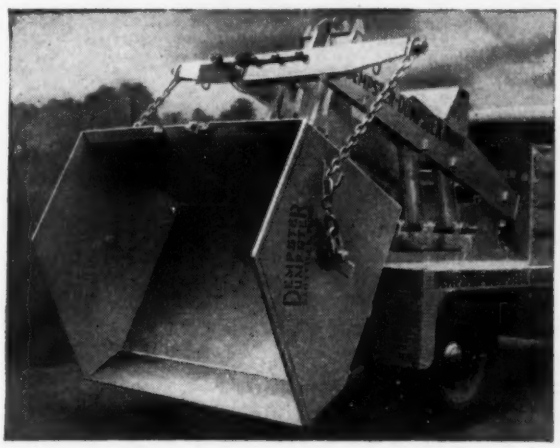
Like other Dempster-Dumpsters—Types "LF" and "LFW," the "ARLF" embodies the principal feature of one truck serving any number of detachable bodies for handling materials of various types. Now, with the Type "ARLF," the Dempster-Dumpster System of materials handling provides equipment for handling materials in capacities of from 1½ to 20 cubic yards, or up to 20,000 pound loads.

With a single truck equipped with the Dempster-Dumpster "ARLF" hoisting unit, any number of various types and capacities of bodies may be served by the same truck unit.

Illustrated directly above, in panel, are three of many different types of Dempster-Dumpster heavy duty, large capacity bodies, built for particular purposes, yet all are served by the same truck. From left to right are shown our Flat-Top, bottom dumping body with self balancing lids; our Pyramid-Top, bottom dumping body, and, a general purpose utility body carrying 15,000 lbs. of feed.

The Dempster-Dumpster system of materials handling by truck assures drastic cuts in investment and maintenance expense where several trucks are normally required for operation. It will eliminate your need for additional trucks because a Dempster-Dumpster equipped truck is never idle . . . is always hauling while bodies are being loaded.

No other trucking equipment saves investment, tires, gas, time and manpower to equal the Dempster-Dumpster. Our engineers will be glad to discuss its possible adaptation to your business.



The photograph above shows the Dempster-Dumpster, Type "LF" with a Skip-Type body in dumping position. Below, the Dempster-Dumpster, Type "LFW" with a special, rubber lined tank, with attached base, for handling chemical liquids.

DEMPSTER DUMPSTER
TRADE MARK REG.

DEMPSTER BROTHERS, INC., 256 HIGGINS, KNOXVILLE, TENNESSEE.

Oakite offers practical help to you in CLEANING or SURFACE CONDITIONING work or parts fabricated from STAINLESS STEEL

In plant after plant fabricating parts from stainless steel, the wide and successful use of Oakite materials designed for cleaning and conditioning surfaces, for use as coolants in machining and grinding operations or for neutralizing after pickling, has resulted in accumulating valuable experience, a small part of which is briefly referred to on this page.

If you are performing any of the operations described, our Technical Representative in your locality can be of service in submitting recommendations that should prove helpful in reducing unit cost and in obtaining improved results. Your problems invited and promptly answered.

Cleaning Stainless After MACHINING

Lubricants used in drilling, tapping, reaming, milling or other operations on stainless steel are easily and rapidly removed by various specialized Oakite cleaning materials used either in connection with dip tank, electro-cleaning method or in automatic washing machine. Enlist Oakite experience.

Cleaning Before ANNEALING

In drawing chromium nickel stainless, the lubricants used should be removed before annealing. Neglect to do this results in formation of a crusty scale. Dip tank, anodic or automatic washing machine cleaning with recommended Oakite materials does fast, low-cost job. In spinning stainless, same cleaning operation is good practice to remove spinning lubricants before work is annealed.

WET GRINDING Stainless

For keeping work cool and wheel free cutting in wet grinding, use Oakite Soluble Oil in recommended dilution. It provides a stable emulsion and may be used in a wide range of dilutions.

Cleaning Before BLACKENING

Before the application of color, blackening or similar chemical finishes to stainless steels, either for increasing corrosion resistance or appearance, or both, it is extremely important that all oil, grease, scale and other foreign matter be completely removed. Dip tank or automatic washing machine method, using recommended Oakite materials will help you do this work quickly, and economically.

Cleaning After Oil QUENCHING

Where oil quenching follows annealing, parts or work may be immersed in recommended Oakite cleaning solution to remove oil quickly and thoroughly to condition work for subsequent operation.

NEUTRALIZING Stainless After PICKLING

After acid pickling procedure to remove scale, thorough rinsing and neutralizing should follow. To help you handle this work on a fast, low-cost, efficient basis various performance-proved Oakite materials are available to put parts or work in prime condition for subsequent operation.

Oakite Products, Inc., 26 Thames Street, New York 6, N. Y.

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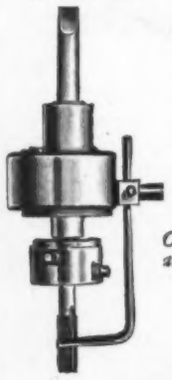

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" 0	⅛" ⅛"
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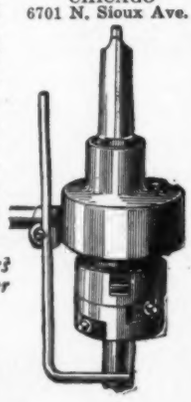

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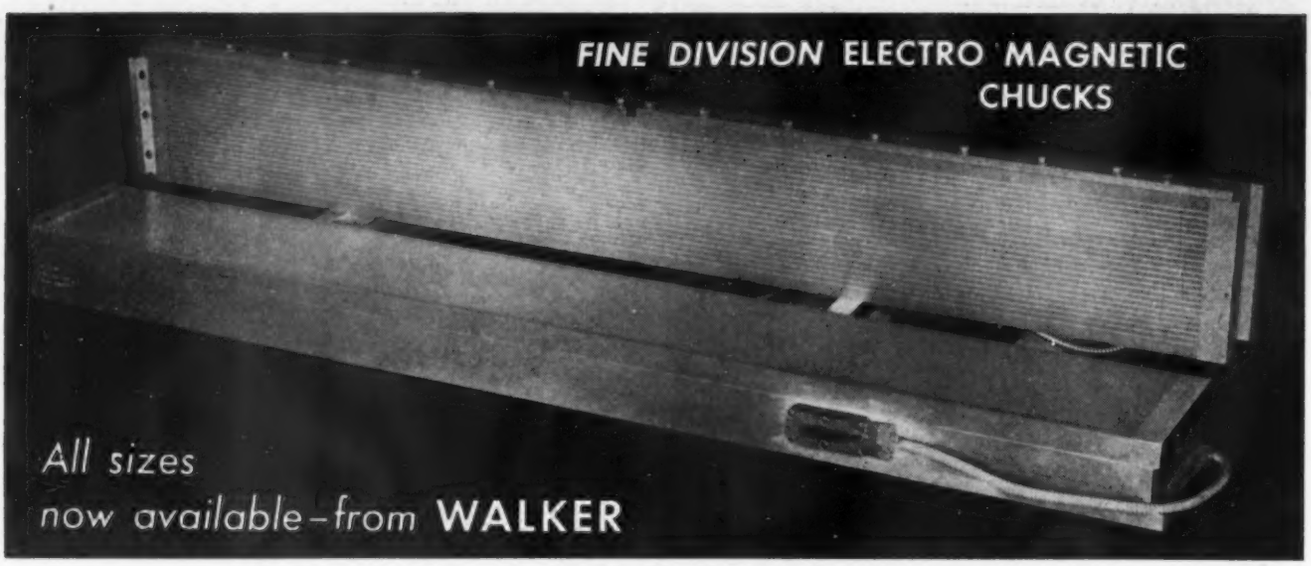

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5/32″	12	9	1.50	23/64″	12	9	2.50
11/64″	12	9	1.50	3/8″	12	9	2.50
3/16″	12	9	1.50	25/64″	12	9	2.75
13/64″	12	9	1.60	13/32″	12	9	2.75
7/32″	12	9	1.60	27/64″	12	9	3.00
15/64″	12	9	1.75	7/16″	12	9	3.00
1/4″	12	9	1.75	29/64″	12	9	3.25
17/64″	12	9	1.85	15/32″	12	9	3.25
9/32″	12	9	1.85	31/64″	12	9	3.25
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21/32″	15	12	8.00	31/32″	15	12	14.00
11/16	15	12	8.25	1″	20	15	16.00
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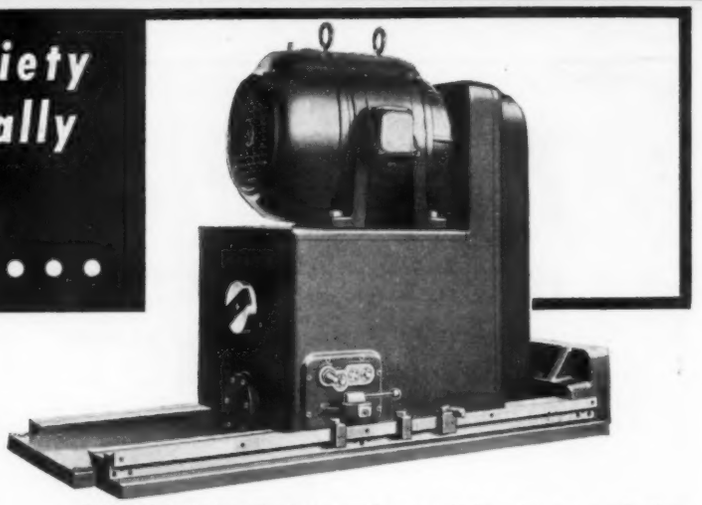

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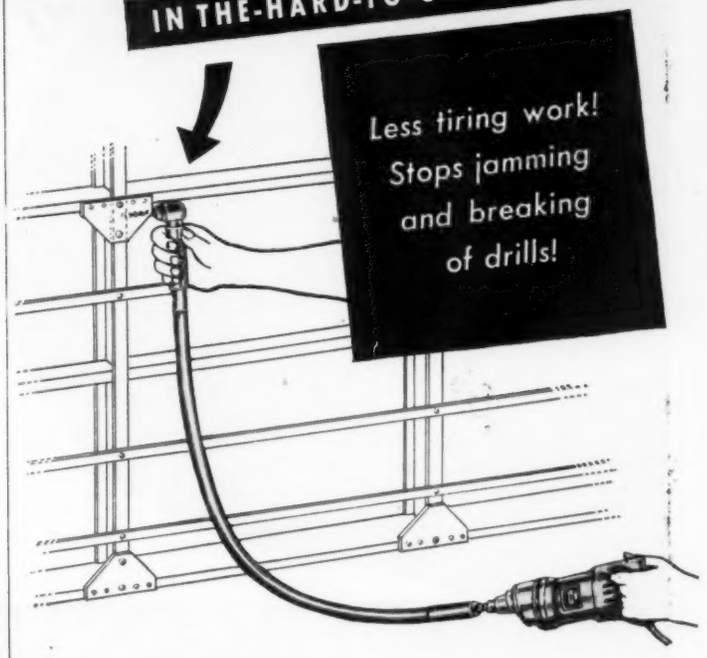

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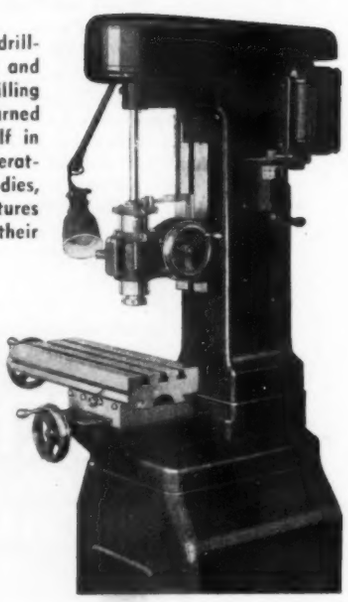

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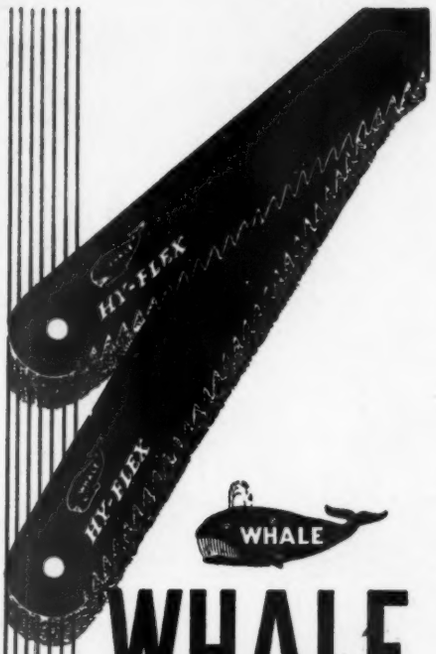

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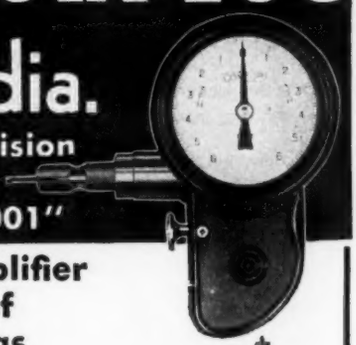

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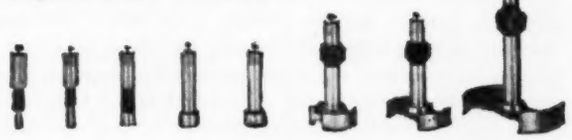

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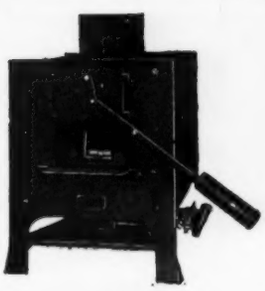

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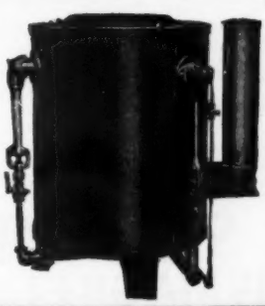

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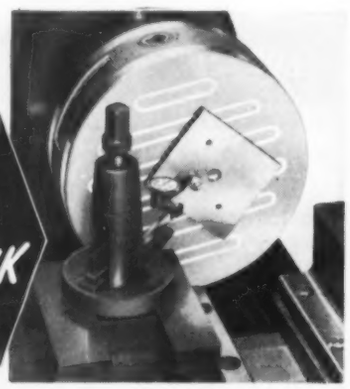

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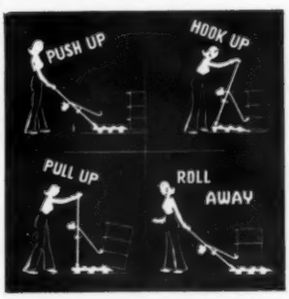

ROLOCK, INCORPORATED
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YOU'LL GET MASS PRODUCTION WITH STATE FOUR-CUTTERS

A glance at the Four-Cutter shows that it's built for fast, accurate boring. Take the tough job of core drilling, for instance. The bits of the Four-Cutter counterbalance each other; so the bar doesn't spring away from the work. Furthermore, the chips have plenty of clearance; no binding and choking.

After a lot of punishment, the bits naturally become dull. But the Four-Cutter bits are easy to dress. Just loosen the setscrews, run out the bits with the follow screws, and you have material for new cutting edges.

FIFTY STANDARD SIZES

Four-Cutter Boring Bars with plain bodies are made in 20 sizes . . . Four-Cutter Core Drills with fluted bodies are made in 30 sizes . . . ranging from ¾" to 4¾" minimum cutting diameters. Extension of the bits provides greater cutting diameters—⅛" increase in the smallest size; 1¼" in the largest.

Special models are built to order—with two or more clusters of bits; with wear strips, pilots, collars, facing bits, oil holes, etc.

Mail coupon or write for particulars. Also indicate if you desire information on DIALSET Tools and VELSEY Surface Plates.

STATE MANUFACTURING & CONSTRUCTION CO.
1940 N. DIXIE HIGHWAY, FRANKLIN, OHIO.

Send information on FOUR-CUTTER Drills; also on ☐ DIALSET Boring Tools and ☐ VELSEY Black Granite Surface Plates.

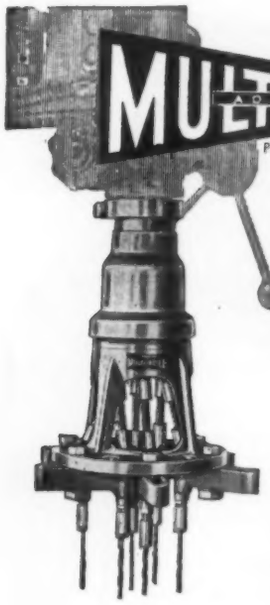
INDIVIDUAL

COMPANY

STREET ADDRESS

CITY, ZONE, STATE

MULTI-DRILL
ADJUSTABLE
PATS. PENDING



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Drill 6 Holes at One Stroke— Adjustable for *any* Pattern!

Your drill presses equipped with adjustable MULTI-DRILL heads will

- Reduce costs thru multiplying your present drill press production
- Conserve valuable floor space in your shop or departments
- Reduce your equipment investment
- Often save their cost on the first job

The MULTI-DRILL attaches conveniently to most ½" drill presses. Its six radially adjustable spindles are quickly set to any hole pattern within 5" circle—11/16" minimum centers. Standard capacity 3/32" to 17/64" drills. Many modifications are available for your special applications at slight additional cost.

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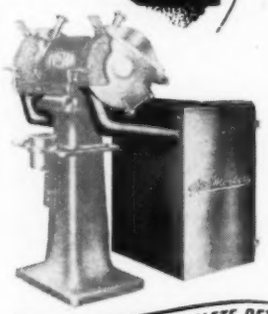

THE AIR MASTER keeps dust and grit out of your plant... instantly sucks them from the whirling wheels of your grinders and buffers. Dust and grit, tiny but destructive enemies of health and machinery, are completely eliminated right at the moment they fly off the wheels.

The AIR MASTER keeps the air clean. It provides healthful working conditions for your employees... keeps expensive machinery in working order by protecting delicate bearings and moving parts.

Install the AIR MASTER in your plant. It is fully self-contained... efficient, rugged, dependable. A size for every grinder and buffer.

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The Cincinnati
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THE CINCINNATI ELECTRICAL TOOL CO.
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. . . the tool that converts drilling machines into key-seaters and saves time and money

• With this modern tool you can handle keyseating jobs not suitable for keyseating machines on any of your drill presses or radials. Keyseats with parallel sides, accurate in depth and in perfect alignment with bore axis are assured.

The National Keyseating Miller mills, keyseats in one cut. It can be used on offset holes and blind holes. Work clamping is unnecessary. We also manufacture oil-grooving millers.

Made in twenty-seven different diameters from ½" to 3½". Several widths of cutters can be used in each size.

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See our Advt. on page 250 Dec. 6, '45 American Machinist

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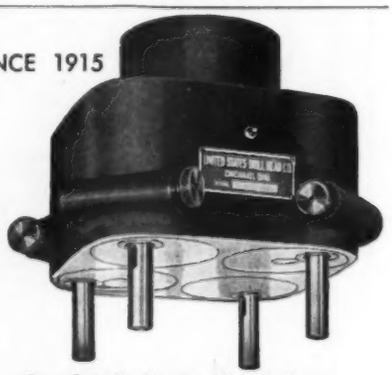
DRILLING TAPPING & BORING HEADS



Four Spindle Head. All Spindles Adjustable for equally spaced holes.

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UNITED STATES DRILL HEAD CO., CINCINNATI 4, OHIO

American Machinist 1946 Where-To-Buy Directory

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American Machinist's "Where - To - Buy Directory", just off the press, is now being distributed.

Here, under one cover, is a revised, representative list of manufacturers of metalworking equipment, tools, accessories, materials and supplies, plus a directory of contract work facilities.

Your copy of this handy 32-page booklet will be mailed promptly on request. Please use the coupon below.

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(or for micrometric tests the "TUKON" Tester)

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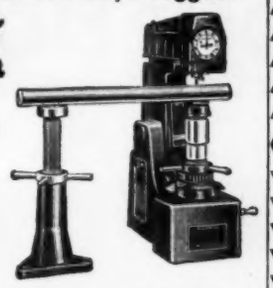

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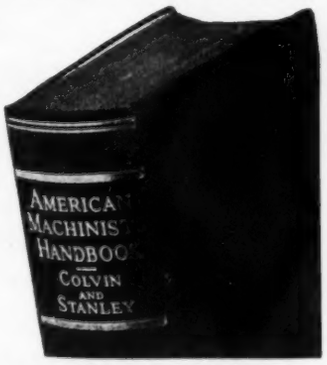

AMERICAN MACHINISTS' HANDBOOK

By FRED H. COLVIN, Editor Emeritus, *American Machinist* and FRANK A. STANLEY, Editor, *Western Machinery and Steel World*

Just where can any worker find as much and so wide a variety of helpful material as is given in this well-planned and well-organized handbook? Just think of being able to find the answer—the "right" answer—to any question—"quickly"—layouts, feeds, speeds, tools, jigs, fixtures, materials, standards, tolerances—a wealth of the most useful information applicable to problems that arise in every type of shop or plant, whatever its size, whatever its special problems.

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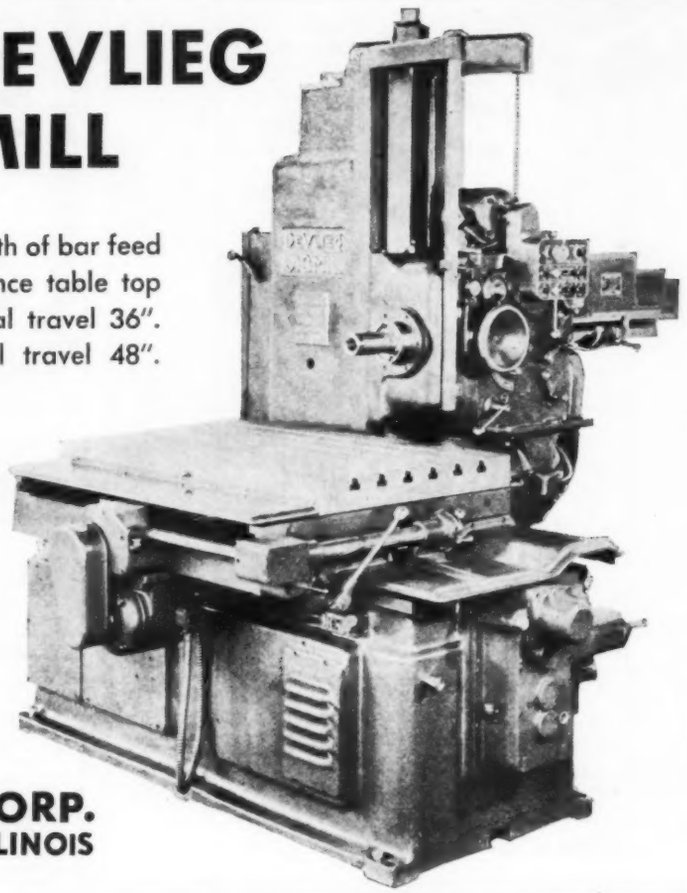

Diameter of bar 3″, No. 5 Morse Taper. Length of bar feed 15″. Total with reset 20″. Maximum distance table top to spindle center 36″. Spindle head vertical travel 36″. Table cross travel 14″. Table longitudinal travel 48″. Table working surface 30″ x 48″. Spindle speeds (12) 30 to 800 R.P.M. Spindle feeds (6) .0025 to .030. Table feeds (12) .5 to .22. Rapid traverse rate per minute 120″. Arranged for Motor Drive with 2 Master Motors.

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Complete with electrical equipment. Weight about 16,500 lbs.

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Additional Searchlight Advertising on pages 300-315

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PRECISION MACHINE PARTS
THREAD GRINDING & MILLING
GRINDING:

Centerless, Cylindical and Crankshaft;
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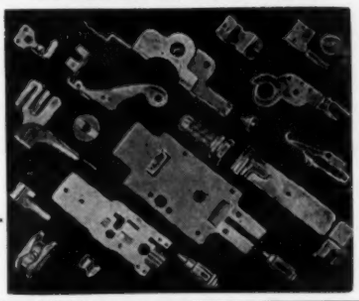
STAMPINGS AND ASSEMBLIES
IN ALL KINDS OF METALS



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Quality work by skilled mechanics is assured. Send your blueprints or samples today.

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ON CONTRACT BASIS TO YOUR SPECIFICATIONS

We offer a complete service for the Engineering, Development, and manufacture of metal parts, assemblies, and machines.

Fully equipped, modern machine shop with complete production setup for all types of machine work.

Send blueprint or sample for prompt quotation without obligation.

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SPECIALTIES — PRECISION WORK

Available capacity for automatic screw machine products up to 1⅝" diameter.

Equipped for secondary operations: Thread rolling and chasing, centerless grinding, slotting, drilling, heat treating, and plating.

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Do You Need NEW MACHINERY or SPECIAL EQUIPMENT for PRODUCTION

We have over 30 years wide and varied precision experience. Engineering and Shop Facilities to meet your requirements.

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Mechanical Development
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● Machines and Parts, ● Special Tools and Fixtures, ● Cam Milling, on Contract

Your engineering problems will receive efficient and economical service in our modern plant manned with skilled workers. Contact us today for prompt quotations on your blueprints or samples.

Designers and builders of wire and ribbon stock forming machines.

THE A. H. NILSON MACHINE COMPANY, BRIDGEPORT, CONN.

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200-Ton Capacity for hobbing mold cavities. Embossing, etc. also fast delivery on presses to your specifications.

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Any material, up to 14" diameter. Large quantities required. Send blueprints or samples for estimate.

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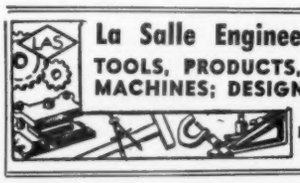

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SEND B.P. FOR MFG. COMPLETE ASSEMBLIES
Tool—Jigs—Dies
Screw Machine and Turret Lathe Work
Stampings—Gears
POSSY'S TOOL & MFG. CO.
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For All Kinds of Castings, Large or Small
MATCH PLATE WORK A SPECIALTY
Put your pattern problems up to us – we will take care of them.

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2" to 3½" six spindle automatic screw machine capacity open including secondary operation equipment.

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PROPOSALS, 30 cents a line an insertion.

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BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals.)

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AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. A.M.

NEW ADVERTISEMENTS received by 10 A.M. May 22nd will appear in the issue of June 6th subject to limitations of space available

WANTED

MECHANICAL ENGINEER

Must be thoroughly experienced in all gear manufacturing problems as well as designing; only those with extensive gear experience need apply. Exceptional opportunity. Write full history including name of university and year graduated; names and addresses of all former employers; age; salary desired.

P-581, American Machinist
330 W. 42nd St., New York 18, N. Y.

PRODUCTION ENGINEER

EXPERIENCED IN PLANT AND ASSEMBLY LINE LAYOUT, TOOL DESIGN, PRODUCTION PLANNING AND CONTROL. RAPIDLY EXPANDING INDIANA CORPORATION NOW MANUFACTURING PRECISION INSTRUMENTS, ELECTRONIC AND MECHANICAL. OPPORTUNITY TO GROW WITH COMPANY. PERMANENT POSITION. SALARY OPEN. WRITE IN DETAIL GIVING AGE, EDUCATION, MARITAL STATUS, PAST EXPERIENCE, SALARY DESIRED, ETC. ALL REPLIES CONFIDENTIAL.

P-674, AMERICAN MACHINIST
520 N. Michigan Ave., Chicago 11, Ill.

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Must have intensive experience in the designing and production of screw pumps. Write names and addresse of all former employer; age; alary deired.

P-611, American Machinist
330 W. 42nd St., New York 18, N. Y.

WANTED

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By machine tool manufacturer in Detroit area. Must have knowledge of automatic multiple drilling, tapping and boring machine tools; automatic indexing and transfer type; and thoroughly experienced in hydraulics as applied to machine tools. Good opportunity for capable man.

P-673, AMERICAN MACHINIST
520 N. Michigan Ave., Chicago 11, Ill.

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DIE SINKER: Experienced on die casting die work for day shift in a modern shop. Good wages with manufacturer in Esex County, N. J. P-675, American Machinist, 330 W. 42nd St., New York 18, N. Y.

OLD ESTABLISHED and prominent machine tool builder located in Connecticut has position for qualified man to take charge of advertising and sales promotion. Must have thorough knowledge of machine tools. P-676, American Machinist, 330 W. 42nd St., New York 18, N. Y.

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SALES ENGINEER: experienced selling flexible shaft and flexible shaft equipment to manufacturers, hardware and automotive trades. Excellent opportunity to grow with line. Well established firm. Replies confidential. SW-677, American Machinist, 330 W. 42nd St., New York 18, N. Y.

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SALARIED POSITIONS $2,500-$25,000. This thoroughly organized confidential service of thirty-six years' recognized standing and reputation carries on preliminary negotiations for supervisory technical and executive positions of the calibre indicated through a procedure individualized to each client's requirements. Retaining fee protected by refund provision. Identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 266 Dun Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

MECHANICAL ENGINEER: Desires position as Chief Engineer in small or medium size company. 20 years experience in design, machine shop, production, plant management, cooperative, resourceful, inventive, good character, successful record. PW-646, American Machinist, 330 W. 42nd St., New York 18, N. Y.

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Auction Advertising—See page 298

WANTED

SALES ENGINEERS

To represent a modern gear manufacturing plant. Must have a degree in mechanical engineering as well as extensive selling experience in the gear industry. Write full details including name of university and year graduated; names and addresses of former employers; salary and territory desired and other pertinent details.

SW-609, AMERICAN MACHINIST
330 W. 42nd St., New York 18, N. Y.

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PATENTS COPYRIGHT, Booklet "General Information concerning inventions and patents" and "Fee Schedule" sent without obligation. Established 1915, Lancaster, Allwine & Rommel, Suite 453, 815-15th St., N.W. Washington 5, D.C.

(Continued on page 302)

Selling and Business Opportunity Advertising on page 302

EVERY ITEM GUARANTEED AS REPRESENTED

FALK FOR DEPENDABILITY IN REBUILT MACHINERY

AUTOMATICS

1—#00G Brown and Sharpe Standard Speed
1—#0G Brown and Sharpe Standard Speed
2—#00 Brown & Sharpe Standard Speed
1—1¼" Cone 4-spindle Automatic, Motor Driven, Threading Spindle.
1—#515 National Acme 1⅝" 4-spindle Automatics, complete
1—#55 National Acme 1⅝" 4-spindle Automatics, complete
1—#2G Brown & Sharpe Automatic. Needs rebuilding. Cheap.

LATHES

14" x 6' Hendey Toolroom, Q.C.G.
14" x 12' Hendey Toolmakers, motor drive.
16" x 6' Rockford Toolroom Lathe.
16" x 6' American Motor Driven Lathe.
16" x 8' American Motor Driven, taper.
27" x 18' Lodge & Shipley Geared Head.
26" x 12' Putnam Quick Change Gear.

TURRET LATHES

4—#4 Warner & Swasey Hand Screw Machines, arr. Motor Drive.
2—#4 Warner & Swasey Universal Hand Screw Machines, arr. Motor Drive.
16" Warner & Swasey Brass Lathe.
#2A Warner & Swasey Universal
#6A Potter & Johnson Automatic Chuckers.
#3R Gisholt Universal like new.
#4 Warner & Swasey with Cross Sliding Turret, Motor Drive.
#4 Foster Turret Lathe.
3—Morey #2G Geared Head Turret Lathe, motor drive (late model)
2—Simmons #2 (microspeed) Turret Screw Machine (late model)

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30" x 30" x 10' Cinn. Heavy Pattern, 2 Hds.
20" x 20" x 24" N.-B.-P., Planer Shaper.
26" x 26" x 8' Gray Planer, 2 heads

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3' 9" column Cincinnati-Bickford.
3' 9" col. American, S.P.D.
3' Dreses, 10" col. QCG., M.D.
5' Arm 13" Column Cincinnati-Bickford.
5' Arm, 14" Column Fosdick, motor drive.
5' Arm 14" Col. Fosdick.

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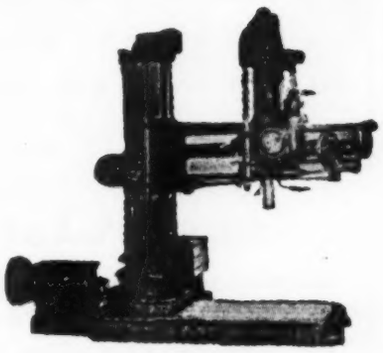
Lennox Splitting Shear ¾" cap.; 8' throat.
Lennox Bevel Shear, ¾" cap.
Gould & Eberhardt Slitting Shear, 10 ga.



Cincinnati-Bickford 5' Arm, 13" round column with air clamp. Oil grooved, tee slotted base, side base, with plain box table with #5 Morse Taper spindle. Motor drive.

Bertsch 3"x36" Geared Slip Roll Former.
Niagara 48" Roller Leveller, 6 Rolls.

GRINDERS

1—#3 LeBlond Tool and Cutter, Motor Drive
1—#11 Brown & Sharpe Cylindrical Single Pulley Drive
#33 Abrasive Vertical Surface.
#3 Abrasive Horizontal Surface.
12" No. 22 Heald Rotary Surface Grinder.
16" Persons-Arter Rotary Surface Grinder.
#12 Greenfield Internal Hydromatic Grinder, sizematic type, complete with Tank and Pump. 15" swing, 5" hole, 4" dee.
Oliver Model 51 Drill Grinder; 1½" cap.
#2 Brown & Sharpe Surface Grinder.
#70 Heald Internal Grinder.
#60 Heald Cylinder Grinder.
10" x 18" Norton Cylindrical.

Blanchard Grinder #16, 30" dia. magnetic Chuck, 25 HP 3-60-440 V Motor.
2—#2 Cincinnati Centerless Grinder.
Pratt & Whitney Vertical Surface Grinder, 14" x 36" with 10" x 36" Magnetic Chuck. Ball Bearing Spindle. Perfect Condition.
#2 Cincinnati Universal Tool and Cutter

MILLING MACHINES

#3, #4, #5 Cinn. High Power, Plain, S.P.D.
No. 1 Bickett Vertical Bench Miller
#1-#1½-#2 Brown & Sharpe Plain Miller.
P & W 2½" Duplex Spline Miller.
Hall Planetary Thread Miller 24".
#8 Lees Bradner Thread Miller.
#1, #2 Kempsmith Plain Millers.
#2½ LeBlond Universal.
3B Hendey Universal Miller, single pulley drive.
1—Cincinnati #4 Vertical Milling Machine, H.P., S.P.D. Geared feeds and speeds.
Knight Vertical Milling Machines—#1, #1½, one each, motor drive.

BORING MILLS

100" Niles-Bement-Pond Bor. & Turn. Mill.
3½" Bar Landis-Rochester Horizontal Boring Mill, Model #36.
#31 Lucas Horizontal Boring Mill, 3" bar.
72" Cincinnati Heavy Pattern Vertical Boring and Turning Mill.

DRILLING MACHINES

Avey, 2 & 3 spindle Prentice, 4 spindle.
Henry & Wright, 6 spindle, #2 M. T.
Fosdick 13" Super speed 4-spindle drills.
Natco #12, 12 spindle #1 M. T.
2—Natco #14, 22 spindle Rectangular head Drilling Machine, #2 M.T.

POWER PRESS HEADQUARTERS

#4 Bliss D. C. Forging Press.
200 ton A.C.F. Hydraulic Press. Bed 24" x 36", 4-post.
75 ton H.P.M. 2 post, Hydraulic Press.
#1 Bliss Straight Side, double action, Cam Press. Plain flywheel drive, double roll feed.
#22C Ferracute Plain, motor drive.

SHAPERS & GEAR CUTTERS

20" Gould and Eberhardt Single Pulley Drive
#1 Adams Gear Hobbers, Belt driven (3).
21" Smith & Mills B.G. Helical Gears.
24" Gould & Eberhardt Shaper.

MISCELLANEOUS

Thomson Cutter and Creaser, 12½ x 18½.
Heat Treating Furnaces for the tool room.
Hydraulic Pumps—Hele Shaw, Racine, Oil Gear, Motor Driven.
Blake and Knowles 12 x 2 x 12 Simplex Type, Hydraulic Steam Pump, 2000 lbs. pressure with 80 to 125 lbs. steam, delivers 9 gallons per minute.
No. 7B High Speed Riveting Hammer, cap. ¾" to 1½. New this year.
#5A High Speed Riveting Hammer.
Baker #0 Keyseater 1" x 9" Cap.
1—Paragon Continuous Blue Printing Machine, complete with dryer, motor driven

Waterbury-Farrell Cold Header, double stroke, open die, ½" x 6".
Manville #3 Thread Roller, ⅜ capacity
#30 Waterbury-Farrell Thread Roller. New 1943.

BUY FROM STOCK
Telephone
MAIN 6347-6348

FALK
MACHINERY COMPANY
Machinery Merchants

18 WARD ST.
ROCHESTER 5
N. Y.

SEARCHLIGHT SECTION

SELLING OPPORTUNITY WANTED

(Continued from page 300)

MANUFACTURERS: ACCOUNTS solicited by sales engineers representing manufacturers in Indiana, Ohio, Michigan. Designing staff available. Include literature with proposal. Barton and Burns, P. O. Box 373, Fort Wayne, Ind.

MANUFACTURERS: MACHINE tools and industrial equipment: Products must increase operation efficiency and reduce manufacturing costs. Manufacturers representative with finest contacts with machine shops and manufacturers of metal products in northern Illinois excluding Chicago seeking three additional quality product lines. Background—Graduate Apprentice Machinist, Purchasing, Sales, Industry Advisory capacity war-time government agency. RA-651, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

MANUFACTURERS REPRESENTATIVE
CLEVELAND AND VICINITY

Resident of this area for past 15 years, with 25 years Tool Engineering experience, invites correspondence with manufacturers of tools and machines salable to the machine tool industry IN NORTHERN OHIO.

RA-654, AMERICAN MACHINIST
520 North Michigan Ave., Chicago 11, Ill.

MACHINE TOOLS

MANUFACTURE & SALE IN GREAT BRITAIN and Continent

Advertiser, successful English production engineer and sales organizer—with wide business experience and training in machine tool manufacture, and with good connection with all leading tool dealers and merchants, excellent contacts with Government departments, Purchasing Commissions and exporters—invites correspondence in strictest confidence with American or Canadian manufacturer of machine tools contemplating establishing production plant and organization for manufacture and sale in Gt. Britain, or conferring European manufacturing and selling rights. Expert knowledge technical publicity, marketing and sales organization. British capital sought and obtained if necessary.

BO-670, AMERICAN MACHINIST
330 W. 42nd St., New York 18, N. Y.

WANTED TO BUY

We are interested in the purchase of a business manufacturing one or more of the following products:

- Taps and Dies
- Reamers
- Counter Bores
- Die Sinking Cutters
- Standard and Special Form Tools
- Plastic Molds
- Drills
- Automatic Self-Opening Die Head
- Acorn Type Dies
- Tapping Head

Please send complete information and advertising printed matter. All replies will be held in strict confidence. Advertiser is a leading manufacturer in the metal working field.

BO-672, AMERICAN MACHINIST
520 N. Michigan Ave., Chicago 11, Ill.

FOR SALE—PAINT
ZINC, CHROME, PRIMER
NAVY SPEC.-52-P-18
Finest Material Made—Packed in New 5 Gallon Container.
Mid-Western Steel Products Co.
7420 S. ACHLAND CHICAGO 36, ILL.
VIRGINIA 0080

WANTED—New Products

Railway rolling stock accessories and equipment . . . Round House Equipment . . . Similar or related products selling to industrial markets.

Our client, an established manufacturer, will buy a successful product or a company making one.

PLEASE WRITE. Communications held confidential.

CHARLES H. WELLING & CO., INC.
52 Vanderbilt Ave., New York 17, N. Y.
INDUSTRIAL CONSULTANTS
New Products — New Processes

FOR SALE

#5 Reed Prentice Jig Borer and Vertical Boring Machine Complete with 7½ HP Motor
New Haven Key Slotter 32" Dia. Table with 2 HP Motor
Barret Horizontal Boring Mill Cuts Up to 40" Dia. Circle, with countershaft
Barret Horizontal Boring Mill Cuts Up to 36" Dia. Circle, with Countershaft
Barnes 22" Swing Hydram Drill with Hoeffer EC4 Head, Direct Connected to 5 HP Motor
Wickes 12" Bending Roll Driven by 2 Cylinder Geared Steam Engine

Contact R. W. HOMAN, *Purchasing Agent, Phone 3-1675*

THE C. H. DUTTON COMPANY
630 Gibson St., Kalamazoo 6, Mich.

THREAD GAGES—PLUG AND RING

Slightly used, NF-2 & 3, ¼ to 1", 6, 8, 10 M.S. Also 1 to 4" N.S.
LESS 75 Percent Discount.

ADJUSTABLE SNAP GAGES. ALL SIZES. ½ to 8".
LESS 75 Percent Discount.

DE WITT TOOL COMPANY
173 GRAND STREET NEW YORK 13, N. Y.
Send For Our Bargain Circular

VERTICAL BORING MILL

96" Cincinnati Massive Pattern—Actual swing 102"—Two Swivel Heads—Power Rapid Traverse—Motor Drive—Inspection in Operation. Special Price Before Removal $6,750.00.

FS-671, AMERICAN MACHINIST
330 W. 42nd St., New York 18, N. Y.

81 Pc. Set

Precision — Machinists Steel Parallels Gauges—Sizes .050—4".

HARRY RUBIN
551 5th Avenue, N.Y.C. MU. 2-4717

SHEET METAL MACHINERY

NEW and USED—Hand and Power Brakes, Shears, Forming Rolls, Folders, Punches, Rotary Machines, Stakes, Spot and Arc Welders

MONA MEMBER **B. D. BROOKS, INC.**
361 Atlantic Ave., Boston, Mass.

3 Lipe Rollway Pneumatic Bar Feeds for 1" Capacity Hand Screw Machines. Perfect condition.

WANTED GOOD USED CHIP EXTRACTOR

O. P. HELD
2112-14 Westchester Ave., Bronx, N.Y., UN 3-2545

2—36"x22' Bridgeford G.L. Lathe
1—2½" Lucas Horiz. Boring Bar
1—37"x62' Johnson Lathe
1—4' Western Radial Drill, motorized
1—60"x60"x18' Gray Planer 4 heads, motorized, ds mtr.
1—1¾" Model G. Gridley Auto.
1—35A Toledo Press.

INDUSTRIAL MACHINERY COMPANY
810 West National Ave., Milwaukee 4, Wisc.

WANTED

WANTED IMMEDIATELY!

The Following Metal Working Equipment
New or Used

BRAKES: 10 ft.—12 ft., 18 gauge
GAP TYPE SHEARS: 10 ft.—12 ft., 18 gauge
BENCH SHEARS, BENCH BRAKES
FOLDERS: 42" to 60"
GANG SLITTERS: 30" x 18 gauge
All the above hand operated or M. D.

KOOL-VENT METAL AWNING CORPORATION OF AMERICA
Keystone Bldg. Pittsburgh, Pa.

WANTED TO BUY

One used duplicator attachment in good condition for an 8½ D Gorton Vertical Milling Machine with all attachments.

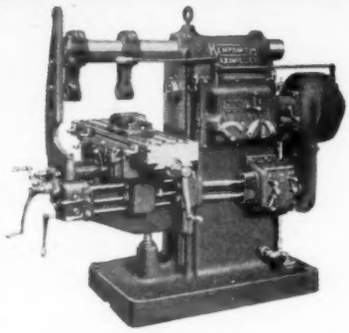
AMERICAN EMBLEM CO., INC.
Utica 1, N. Y.

WANTED — LATHE

Good used sliding bed gap lathe. Must swing 20" over carriage and not less than 11 ft. center bed extended. Must be in good condition.

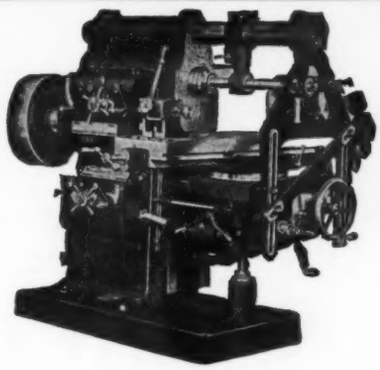
W-655, AMERICAN MACHINIST
68 POST ST. SAN FRANCISCO 4, CALIF.

EMERMAN OFFERS FROM STOCK



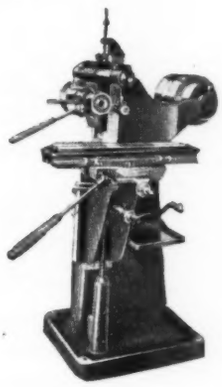
PLAIN

1—No. 2 Ryerson-Conradson Plain Mill table w.s. 13" x 54", with motor
1—No. 2 Cleveland Plain Mill table 13" x 50", with motor
1—No. 2 Milwaukee Plain Mill table 12" x 50", with motor
1—No. 2 Milwaukee Mill table w.s. 11" x 45", univ. hd., with mtr.
1—No. 2 Cincinnati Plain Mill table w.s. 13" x 52", rapid traverse
1—No. 2 Kempsmith Plain Mill table w.s. 10" x 45", with motor
2—No. 2-M Cincinnati Plain Mills table 10" x 49", with motor
1—No. 3-B Brown & Sharpe Plain Mill table 14" x 60", vert. hd., with mtr.
3—No. 3 Milwaukee Plain Mills table w.s. 16" x 60", with motors
1—No. 3 Milwaukee Plain Mill table w.s. 16" x 60", vert. hd., with mtr.
1—No. 3-B Milwaukee Plain Mill table w.s. 16" x 60", with motor
1—No. 3-H Le Blond Plain Mill table 16" x 53"
1—No. 3-B Brown & Sharpe Plain Mill table w.s. 14" x 51", with motor
2—No. 4 Kempsmith Plain Maximills table w.s. 18" x 70", rapid traverse
6—No. 4 Cincinnati Plain Mills table w.s. 19" x 62", with motor
1—No. 4 Cincinnati Plain Mill table w.s. 16" x 58", rapid traverse, vertical head, with motor
1—No. 4-B Milwaukee Plain Mill table w.s. 18" x 76", with motor
1—No. 4-B Milwaukee Plain Mill table w.s. 19" x 76", 2-Sp. vert. hd., with motor
2—No. 5 Cincinnati Plain Mills table w.s. 19" x 68", with motor
1—No. 5 LeBlond Plain Mill table w.s. 20" x 70", with motor
2—No. 5-B Brown & Sharpe Plain Mill table w.s. 21" x 68", with motor



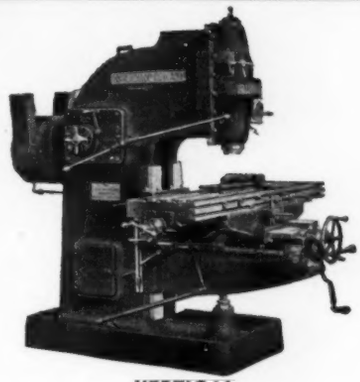
UNIVERSAL

1—No. 1½ Brown & Sharpe Univ. Mill table w.s. 7" x 32", equipped with 4" vise, with motor
1—No. 2 Ohio Univ. Mill table w.s. 9" x 42", 4" vise, with motor
2—No. 2M Cincinnati Univ. Mills table w.s. 10" x 49", equipped with 10" universal dividing head, tailstock and 5" universal vise
1—No. 3A Brown & Sharpe Univ. Mill table w.s. 14" x 60", with motor
1—No. 3-S Cincinnati Univ. Mill table w.s. 12" x 52", with motor
1—No. 4-A Brown & Sharpe Univ. Mill table 17" x 72", with motor
1—No. 5 Cincinnati Univ. Mill table w.s. 20" x 79", power rapid traverse with 12" dividing head and tailstock



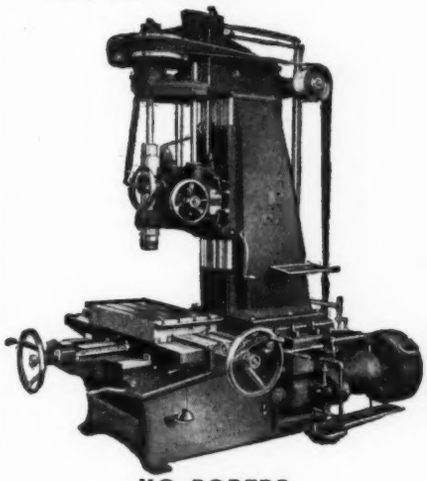
HAND

1—No. 0 Bristol Hand Mill table w.s. 4" x 21"
1—No. 1 Kent Owens Hand Mill table w.s. 5" x 22", chain drive
1—No. 2-RV Kent Owens Hand Mill table 14" x 35" with motor
2—No. 6 Whitney Hand Mills table w.s. 4" x 20", with motor



VERTICAL

2—No. 2 Cincinnati Vert. Mills table w.s. 12" x 47", with motors
4—No. 2½-B Milwaukee Vert. Mills table w.s. 14" x 54", with motors
4—No. 3 Brown & Sharpe Vert. Mills table w.s. 16" x 55", with motors
2—No. 3 Cincinnati Vert. Mills table w.s. 15" x 62", with motors
1—No. 4 Kempsmith Vert. Maximill table w.s. 18" x 76", rapid traverse, with motor
2—No. 5 Becker Vert. Mills table w.s. 13" x 42"
2—No. 6 Becker Vert. Mills table 18" x 61"
1—Model B Becker Vert. Mill table w.s. 12" x 47"



JIG BORERS

1—No. 2 Pratt & Whitney Jig Borer table w.s. 16" x 30", overhang 17", with motor
1—No. 5 Reed-Prentis Jig Borer table 16" x 68"
1—No. 2 Pratt & Whitney Die Sinker overhang 13", table 9" x 13"
1—3A De Vleig Jig Mill, 3" bar table working surface 30" x 48"

EMERMAN MACHINERY CORP.

875 W. 120TH STREET — CHICAGO 43, ILLINOIS

See additional ad on page 298

MOREY DEPENDABLE

SPECIALS:

MORTON boring, drilling, milling and draw cutting traveling head planer 60" stroke

INGERSOLL 42x36x16' Planer Type Miller

NILES-BEMENT-POND, Boring Mill—7" Bar—horiz.

MATTISON 16x24x96" High powered surface grinder

GOULD & EBERHARDT #96H Gear Hobber with Differential

NEARLY ALL BUILT AFTER 1941

MILLING MACHINES—Plain

BROWN & SHARPE No. 2B, No. 4B standard type—Timken Bearing—latest type
CINCINNATI #2 Timken Bearing—Dial Type—latest type
KEARNEY & TRECKER No. 2H, No. 3H Timken Bearing—latest type
KEARNEY & TRECKER No. 2K, No. 3K Timken Bearing—latest type
KEMPSMITH No. 4 Maximiller—Timken Bearing—latest type

MILLING MACHINES—Universal

BROWN & SHARPE No. 2A Timken Bearing—latest type
VAN NORMAN No. 26 Timken Bearing—latest type

MILLING MACHINES—Vertical

CINCINNATI No. 2, No. 3 Timken bearing—Dial Type
GORTON No. 8½D Vert. High Speed—latest type
KEARNEY & TRECKER No. 2H, No. 3K—Timken Bearing—latest type

MILLING MACHINES—Manufacturing

BROWN & SHARPE No. 10, No. 12 Auto. Timken
CINCINNATI 45x48 Hydro, Timken Bearing—latest type
CINCINNATI 4-36 Hydro. Timken Bearing—latest type
CINCINNATI No. 0-8 Vert. & Pl. Auto. Timken Bearing—Latest type
CINCINNATI No. 1-12, No. 1-18 Plain Auto. Timken Bearing—latest type
INGERSOLL 24x24x8' Planer type—1 head
INGERSOLL 36x48x18' Planer type—4 heads
INGERSOLL 42x36x16' Planer type—4 heads
KEARNEY & TRECKER No. 1218 Auto. Timken Bearing—Latest Type
KENT OWENS No. 2 RV Hand Miller—Timken Bearing—latest type
MOREY No. 12M—2 spindles Profiler and Milling Machine
OHIO Auto. 36" table—Timken Bearing—latest type

THREAD MILLING MACHINES

PRATT & WHITNEY 4½x12, 6x20 Model B, Model C latest type
PRATT & WHITNEY 6x120, 6x132—motor drive
MOREY SHIELDS 12x30, 12x60, 12x120, 12x192—latest type

SHAPERS

DILL 18" Vert. Shaper — slotter — Motor Drive
JONES 6" Vertical—latest type
MOREY 10", 14" Vertical—latest type
MORTON 30" Draw Cut
PRATT & WHITNEY 6" Vertical Motor drive
PRATT & WHITNEY 10" Vertical Motor Drive

GRINDERS—Surface

ARTER 8" Rotary Surface
ARTER Automatic Piston Ring
BLANCHARD #10—16" Chuck—motor drive
BLANCHARD #16—26" Chuck—motor drive
BLANCHARD #18—30" Chuck—motor drive—latest type
GALLMEYER & LIVINGSTON No. 25 6"x18"—Hydraulic—latest type
GALLMEYER & LIVINGSTON No. 35 8"x24"—Hydraulic—latest type
MATTISON 16x24x96—Hydraulic—latest type
NORTON 6"x18"—Hydraulic—latest type
NORTON 10x60—Hydraulic—latest type
PRATT & WHITNEY 14x60 Hydraulic—latest type

GRINDERS—Cylindrical plain and universal

BROWN & SHARPE No. 1, No. 2, No. 3, No. 4 Univ.; latest type
BROWN & SHARPE No. 5 Pl, 3x18—latest type
BROWN & SHARPE No. 23 Plain, 10x48—latest type
LANDIS 4x12 Type H Plain Hydraulic—latest type
LANDIS 10x48 Type C Plain Hydraulic—latest type
NORTON 12x36 Univ.; Hydraulic—latest type
NORTON 24x240 Plain—motor drive
NORTON 23x72 Plain—latest type

GRINDERS—Internal, Cutter and Miscellaneous

BRYANT No. 5 Internal—chucking—latest type
BROWN & SHARPE No. 13 Univ. & Tool—latest type
CINCINNATI No. 2 Plain Tool & Cutter—latest type
CINCINNATI No. 2 Centerless—motor drive
HEALD No. 70—Internal—motor drive
HEALD No. 81 Plain Internal—latest type
LEBLOND No. 2 Univ. Tool & Cutter; latest type
PRATT & WHITNEY Contour Cutter; latest type
OLIVER No. 510 Twist Drill—latest type
OLIVER Univ. and Tool
UNIVERSAL Spline shaft; Hydraulic

BORING MILLS—Horizontal

CINCINNATI-BICKFORD 3½" Bar; floor type—latest type
GIDDINGS & LEWIS No. 25T 2½" bar—

YOUR INQUIRIES ARE INVITED . . .

MOREY MACHINERY

USED MACHINE TOOLS

latest type
LUCAS No. 31—3" Bar, No. 33—4½" bar —motor drive
LUCAS No. 42—4" Bar—latest type
NILES BEMENT POND, 5" Bar—floor type
NILES BEMENT POND, 7" Bar—floor type
NILES BEMENT POND, 4½" Bar—Duplex
UNIVERSAL 3" Bar—Timken Bearing—latest type
YODER #3—3" Bar—latest type—Timken Bearing

BORING MILLS—Vertical

BETTS 120"—2-swivel heads, motor drive
BULLARD 2", 36", 42" New Era Type—motor drive
BULLARD 54" Spiral Drive; latest type
BULLARD 86"—2-swivel heads; motor drive
KING 72" 2-swivel heads; motor drive
NILES BEMENT POND 84" 2-swivel heads; M.D.
NILES BEMENT POND 120" 2-swivel heads; M.D.

DRILLS

ALLEN #2, 2-4 spindles
ALLEN #3, single spindle
AVEY No. 2—3 spindles
AVEY No. 2—1 to 6 spindles
LELAND & GIFFORD No. 1—1 & 2 Spindles
NATCO No. 12 Multiple Spindle
NATCO C-13H multiple spindle
PRATT & WHITNEY No. ½Bx50"—2-spindle deep hole—latest type

DRILLS—Radial

AMERICAN 4'11", 5'11"—latest type
CARLTON 3'11"—latest type
WESTERN 4'18", 5'18", 620"—latest type

GEAR CUTTING EQUIPMENT

BARBER COLMAN No. 3 Gear Hobber
BROWN & SHARPE No. 13 Gear Cutter
BROWN & SHARPE No. 6x60 Gear Cutter
CINCINNATI Gear Burnisher
FELLOWS No. 7, No. 7A, No. 77 Gear Shapers
FELLOWS No. 624A Gear Shaper—latest type
GLEASON 3", 6", 11", 18", Bevel Gear Generators
GLEASON 12" Bevel Gear Generator; latest type
GLEASON 10", 15" Spiral Bevel Finisher
GLEASON Bevel gear tester
GLEASON 24" Bevel Gear Planer
G & E No. 96H Gear Hobber, with differential

PLANERS

CINCINNATI 24" Crank—motor drive
CINCINNATI 36x30x5' Box table, PRT, 1 head—motor drive
CINCINNATI 120x96x20'—4 heads box Table, PRT—motor drive
CLEVELAND 48x48x16' Open side, 3 heads, motor drive
DIETRICH & HARVEY 48x48x16' 4 heads, Hydraulic—Motor drive
GRAY 48x48x16' 4 heads Motor drive
HAMILTON 42x42x20', 4 heads, motor drive
LYND FARQUHAR 26" open side Motor drive
NILES BEMENT POND 96x80x20' box table 4-heads Hyd. PRT. Motor drive

LATHES—Engine & Mfg.

AMERICAN 24"x14'—Timken Bearing
HENDEY 14x6' bed, geared head—motor drive
HENDEY 14"x42" Centers; Timken Bearing —latest type
HENDEY 12x54 Centers, Mfg. Type
HENDEY No. 3x54 Centers Mfg. Type
LEBLOND 12x30 Centers Timken Bearing, Latest type
LEBLOND 18x54 Centers, Timken Bearing, Latest type
LEBLOND 16"x102" Centers, Timken Bearing—latest type
LEBLOND 21x16' Bed, geared head
LEBLOND 20x10' Centers—Timken Bearing —latest type rapid production
LODGE & SHIPLEY 16 x 30 Timken Bearing —latest type
LODGE & SHIPLEY 18x8' bed, geared head
LEBLOND 17x9' and 14' bed Timken Bearing Rapid Production
MONARCH 10x20 Centers, Model EE, Timken Bearing Latest type
MONARCH 14x30 Centers, Timken Bearing, latest type
LIBBY 1H-5 Timken Bearing—Latest type
MONARCH 16x54 Centers, Timken Bearing, latest type
MONARCH 30"x10' bed, Timken Bearing
NILES 36"x18' Timken Bearing
REED PRENTICE 14x30 Timken Bearing—Latest type
SENECA FALLS 8"x60" LoSwing Timken Bearing—Latest type

LATHES—Turret

BARDONS & OLIVER No. 3—latest type
CINCINNATI - ACME 5W Timken Bearing — latest type
GISHOLT No. 2L Univ. Timken Bearing
GISHOLT No. 3, No. 4 Univ. Timken Bearing—latest type
JONES & LAMSON No. 3, No. 5, No. 7C Univ. —latest type, Timken Bearing
MOREY No. 2G, 1" Cap. Timken Bearing
MOREY No. 3 Univ.; 1½" Cap. Timken Bearing
MOREY No. 4 Univ.; 2" Cap. Timken Bearing
WARNER & SWASEY No. 1A, No. 2A, No. 3A Univ., Timken Bearing—latest type
WARNER & SWASEY No. 3, No. 4, No. 5 Univ. Timken Bearing—Latest type

AUTOMATIC SCREW MACHINES

CLEVELAND ⅞" to 2½" Model A
CONO MATIC 3½"—4 spindle—latest type

PRESSES

CLEARING TYPE K-1200-30 Knuckle Joint, 200 Tons—latest type
CLEARING Type F-1100-36 Single Action 100 tons—latest type

MISCELLANEOUS

CLEVELAND 12x16" Cutter Relieving Machine
WATSON STILLMAN Hyd. Straightening Press 20 Ton
TREADWELL Pipe Threader 12"
MITTS & MERRILL No. 5 Keyseater
PEERLESS 6x6 Hack Saw—Auto. Feed
MARVEL No. 9, No. 9A Hack Saw
LUCAS #138 Old saw
LEBLOND #2 Deep Hole Borer
PRATT & WHITNEY No. 2A Jig Borer—latest type
MORTON 60" Combination Traveling head planer, milling & drilling

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LIQUIDATORS
of
INDUSTRIAL PLANTS
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REBUILDERS
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MACHINE TOOLS
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MACHINE TOOL PROBLEM

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TELEPHONE—CANAL 6-5360
Detroit Representatives: Morey Machinery Co.,
2832 E. Grand Boulevard, Detroit, Mich.

QUALITY *Machine Tools*

NOW IN STOCK

No. 30A Fosdick Jig Borer, with locating devices, micrometers, measuring rods, motor and controls. New in 1942.

Lake Erie 2500 ton Forming Press, 60 x 58 F. to B. x R. to L. between columns; 95½ x 120 F. to B. x R. to L. bottom platen, maximum daylight 42", stroke 36". Condition equal to new.

AUTOMATICS

5½" Cleveland Model A, single spindle.
No. 61 New Britain, 1⅝" capacity.
16" x 33" Fay Automatic Lathe.
1" x 5" New Britain, six spindle.
⅞" Cleveland Model M, four spindle.
No. 00, 0, 2G Brown & Sharpe.

BROACHES

American H-6-36, Hydraulic, new in 1943.
Lapointe CPC 24 Hydraulic Vertical.

DRILLS

3' Cincinnati Gilbert, motor on arm.
5 ft. Carlton Radial, enclosed head.
No. 12 Colburn, single spindle.
42" Barnes, sliding head.
Allen Sensitive Drill, four spindle.
No. 11 Natco Multiple Drill, 16 spindle.
★ **No. 3 Baush Multiple Drill, 20 spindle, No. 2 Morse Taper, rectangular head 20" x 40".**

GEAR CUTTERS

No. 3 Barber Colman, m.d.
No. 61 Fellows Gear Shaper, m.d.
No. 5AC Lees Bradner Gear Hobber.
6" Gleason Str. Bevel Gear Generator.
No. 5—48" Cincinnati Automatic Gear Cutter.

GRINDERS

36" x 168" Mattison Surface Grinder.
No. 3B Abrasive Surface Grinder.
No. 22 Heald Rotary Surface Grinder.
No. 16—26" and No. 16—30" Blanchard Surface Grinder.
76" Rogers Knife Grinder, Type B.
No. 72A3 Heald Gagematic Internal Grinder.
No. 70 and 75 Heald Internal Grinders.
No. 13 Brown & Sharpe Universal & Tool Grinder.
12" x 28" Landis Universal & Tool Grinder.
10" x 36" Norton Cylindrical Grinder.
No. 2 Cincinnati Centerless Grinder.
★ **No. 3 Cincinnati Centerless, m.d.**

LATHES, ENGINE

13" x 6' South Bend, m.d.
20" x 10' Lodge & Shipley, g.h.
20" x 8' Sidney "Monotrol", g.h.
24" x 30' Lodge & Shipley, g.h.
★ **15" x 30" Lipe Carbo-Matic, new 1943.**

LATHES, TURRET

★ **No. 4L Gisholt, 9¼" spindle, chucking.**
No. 1A, 2A Warner & Swasey.
No. 5 Warner & Swasey Universal, G.H. Timken spindle.
No. 6D Potter & Johnston Automatic Chucking and Turning Machine.

MILLS

★ **No. 36 Van Norman Ram Type, new in 1942.**
No. 4A Brown & Sharpe Universal, s.p.d.
No. 3B Milwaukee, plain, m.d.
No. 2A Brown & Sharpe Universal, m.d.
No. 2 M.H. Cincinnati Plain, m.d.
No. 1 Brown & Sharpe Universal, m.d.
No. 0-8 Cincinnati Plain Automatic, m.d.
★ **18" Cincinnati Plain Mfg., m.d., new in 1943.**
No. 2209 Milwaukee, Table 22" x 158".
No. 3-36 Cinci. Hydromatic Duplex, m.d.
4" Pratt & Whitney Spline Mill.
42" Bullard Vertical Boring Mill.

MISCELLANEOUS

No. 100 Micromatic Hydrohoner.
No. 3 Long & Allstatter Mult. Punch, m.d.
Schraner Crankshaft Lapping Machine, Model B.
8" x 7" Troy Vertical Steam Engine.
No. 72 Etna Rotary Swaging Machine.
Gray Nibbler, ¼" capacity.
Barrett Oil Separator.

PLANERS AND SHAPERS

★ **6" Pratt & Whitney Vertical Shaper.**

SAWS

9" x 9" Peerless, Hydraulic.

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AXELSON 24"x72" Centers, 24 speed—Timken Bearing
AMERICAN 36"x22' Bed
BRIDGEFORD 36'x28', 32', 35' Bed—2 Carriages
NILES—36"x25' Centers—2 Carriages; PRT—Timken Bearing
BRIDGEFORD 42"x35' Bed—2 Carriages
AMERICAN 42"x40' Bed—2 Carriages
LeBLOND 48"x34', 48"x40', Centers; PRT 2 Carriages—Timken Bearing

LATHES—TURRET

BARDONS & OLIVER #5 Univ.; Timken Bearing; chucking
BARDONS & OLIVER #7 Univ.; Timken Bearing; chucking
FOSTER #3F Univ. Fastermatic; Timken Bearing

LATHES—BORING

NILES 30"x50'
NILES 30"x46'

GRINDERS

PRATT & WHITNEY 14"x60" Vertical Surface—Hydraulic
HAMMOND Type WH Model A Pedestal Grinder
FOX #8 Swing Frame

SAWS

PEERLESS 14"x14" Hack
CAMPBELL #401 Cutamatic Wet Abrasive Cutting Machine 6"

PLANERS

LIBERTY 24"x24"x8'; 1 head on cross rail, 1 side head, A.C. Vari. Voltage Drive

MILLING MACHINES

Cincinnati Universal, geared
HALL Planetary Millers, Style C & D
KENT-OWENS #1M Hand; ball bearing, M.D.

BORING MILLS—VERTICAL

NILES 42", 2 swivel heads, power rapid traverse

MISCELLANEOUS

BRINELL Automatic Direct Reading Hardness Testing Machine
SUTTON #2 Single Head Horiz. Straightening Press, to straighten up to 6½" bar.
GREENARD #6 Arbor Press
BLISS #6 Arbor Press
RHENBERG-JACOBSEN Centering Mach.
BUFFALO #16 SS Drill Press

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Grinder, 12" Arter Rotary Surface, M.D.
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Grinder, Brown & Sharpe Surface No. 2, M.D.
Grinder, Covel Surface No. 15, M.D.
Grinder, Cincinnati Universal 12x72
Grinder, Heald Internal No. 70A
Grinder, Leach 7x11, M.D.
Lathe, American 16"x8', geared head, M.D.
Lathe, LeBlond Heavy Duty Automatic No. 12
Lath, Lodge & Shipley 16"x8', geared head, M.D.
Mill, 0-8 Cincinnati Vertical, M.D.
Mill, hand, Kent Owen No. 1, M.D.
Mill, Rockford Rigidmil, M.D.
Mill, Toledo Vertical No. 3V, M.D.
Seam Roller, Quick Work 10A-1, M.D.
Turret Lathe, No. 3 Bardson & Oliver full universal, extra tooling, M.D.
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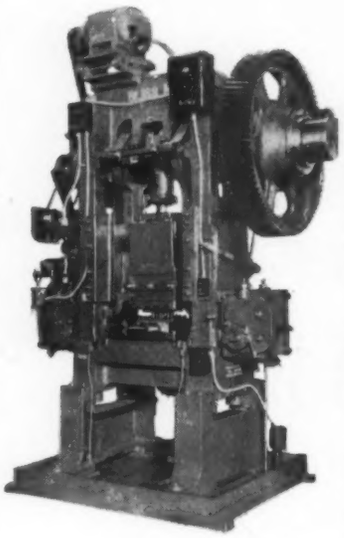

LATHES

48"x44' Niles. G.H. Q.C. M.D.
48"x24' Blocked to 80" Fifield. D.B.G.
36"x14' Niles. Q.C. G.H. M.D.
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16"x6' Monarch. M.D. Late type
Many others from 7" to 98" swing. Niles, Ledge & Shipley, American, Monarch, Hendey, LeBlond, South Bend, Logan, etc.

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#5 Midland. Late type
#2, #3, #4, #5, #1A, #2A, #3A Warner & Swasey
Many others from ⅝" to 6" capacity.

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72"x72"x26' Sellers, 4 heads. M.D.
60"x60"x20' Gray. 4 heads. M.D.
42"x42"x20' Cincinnati. 4 heads. M.D.
36"x36"x18' Cincinnati. 4 heads. M.D.
30"x30"x8' and 10' Powell. 2 heads. M.D.
24"x24"x6' Cincinnati. 2 heads. M.D.
120"x25' and 36"x18' Dietrich & Harvey. Open Side. M.D.

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2½", 3½", 4", 5" Horiz. Binsse, Universal, Bausch
24" to 10' Vertical Bullard, Niles, Cincinnati, Betts, Colburn, etc.

SHAPERS

7" to 32" Rhodes, Smith & Mills, Gould & Eberhardt, Stockbridge, Walcott, etc.

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#2, #3, #4, #5 Vertical. M.D. Brown & Sharpe, Cincinnati, Bridgeport, Baker.
#08 Cincinnati, Vertical. M.D.
Brown & Sharpe, Cincinnati and Briggs Production Millers, M.D.

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2", 2½", 2¾" Cleveland, M.D.
Gridleys, New Britains—latest models

PUNCH & SHEARS

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Blanchard, Brown & Sharpe, Reid, Covel, Thompson, Sanford, Pratt & Whitney—Surface.
#2 and #3 Cincinnati Centerless
Brown & Sharpe, Gallmeyer & Livingston, Cincinnati—Universal Tool & Cutter
#70 Heald Internal, M.D.

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⅛" to 8" Upsetters. Ajax Waterbury
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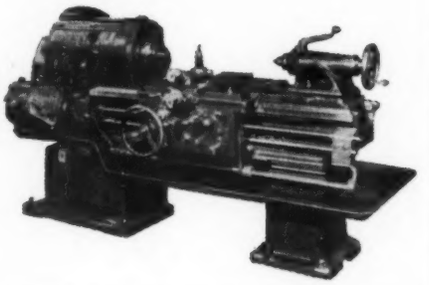
#60¼ Toledo Power Press, 1200 tons
#57 Toledo Press, 100 tons
#87½, #78½, #6 Bliss Presses
Hammers from 100# to 35,000#. Erie, Chambersburg, Niles, etc.

MISCELLANEOUS

Gear Cutters
Bliss, Rafter, Ryerson Rolls
Saws
Many other special machines



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KEYSEATER—MITTS & MERRILL No. 6, M.D.
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Drill, #25 Foot-Burt, motor driven
Drills—New—18" Royal Motor driven (10)
Gear cutter, Brown & Sharpe #3—26
Gear cutter, Gould & Eberhardt 42"
Grinder, Webster and Perks #1-¾ motor drive
22" Buffalo Pr. Fd. Motor Drive, New
16"x8' Hendey Lathe, Quick Change Gear
Magic Chucks, #1-2 & 3 and Collets
Pipe Machine, 8" Oster motor drive
Planer 24"x24"x6' Pease, motor drive
Punch & Shear, two ½" & ¾" capacity
Shaper, 24" Gould & Eberhardt
Turret Lathe, 2" Acme & Warner & Swasey
Welders—Arc & Spot in Stock—New

Outfit; about 27 fine machine tools, drills, lathes, and 5 milling machines, plain and Uni. Tell us definitely what you want as our list is incomplete and only partial.

The above list is only a fraction of our stock which changes almost daily, therefore, tell us definitely what you want since we are adding considerable number of machines to our stock which are too many to list. What we have today may be sold tomorrow, so a list is really not dependable.

THE OSBORNE & SEXTON MACHINERY CO.
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3 #33 Hand Power Steel Economy Balers—slightly used. Good as new. Original cost $400 each.
2 Chicago Pneumatic Riveters #Model T9018—Size 535D. Slightly used—good as new. Original cost $1800 each. Complete with hammers, hose, hoists, etc.
1 Turret Lathe #2 Warner & Swasey Air Chuck. Brand new cross-feed. Extras. Late model—Standard machine. Used. Condition excellent. Original cost $3500.
1 Power Press Adriance #34 Straight Side Single Action—95 ton. Bed—14x18. Stroke 2½". Slightly used—equal to new. Original cost $4500.
1 Power Press Bliss 304. Straight side Single Action—65 ton. Bed—18x18. Stroke 1½". Used—excellent condition. Original cost $2750.
6 Double-Head Standard Landis Threaders complete with extra tool-holder. Handle from ¾" to 2". Power feed. 3 new in crates—3 only slightly used. Original cost $2500 each.
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60" KING, two swivel heads, all geared power feeds, M.D.
72" COLBURN, two swivel heads, all geared power feeds, M.D.
73" NILES-BEMENT-POND, two swivel heads, all geared power feeds, M.D.
84" CINCINNATI Rapid Production Type, one swivel head, one turret head
96" CINCINNATI Rapid Production Type, two swivel heads, M.D.
100" NILES-BEMENT-POND, two swivel heads, all geared feeds, M.D.
120" BETTS Heavy, two swivel heads, all geared feeds, power rapid traverse.
10/16' CINCINNATI Massive Pattern, two swivel heads and extension boring head.
14'-20' NILES-BEMENT-POND Extension Type, 2-swivel heads, all geared feeds, table 144"x12"

MILLERS

42" x 26" x 12' INGERSOLL Planer Miller, 4 heads, M.D.
No. 4 CINCINNATI High Power Plain, Power rapid traverse table 16½" x 64". Single pulley belt drive or AC or DC.
Nos. 2, 3 and 4 CINCINNATI High Power Vertical adjustable head, P.R.T.
No. 5 CINCINNATI Plain Rectangular overarm, table overall 21" x 83".

LATHES

30" x 18' LODGE & SHIPLEY Selective geared head, taper attachment.

36" x 30' LODGE AND SHIPLEY 18 speed selective geared head screw cutting engine lathe, 2 carriages, AC or DC motor drive.

42" x 36" PUTNAM Geared Head, 25' between centers. Quick change gear box.
#3 NILES-BEMENT-POND, axle lathe, M.D.
42" PUTNAM Car Wheel, M.D.
79" NILES-BEMENT-POND Driving Wheel, M.D.
60" x 48' N-B-P Geared Head Engine Lathe.

RADIAL DRILLS

4' AMERICAN Plain triple purpose enclosed head drill, tapping attachment.
5½" AMERICAN Full Universal Triple Geared Tapping Attachment.
6' AMERICAN Triple purpose, plain radial, motor on arm.

PLANERS

48" x 48" x 15' NILES-BEMENT-POND four heads, 230 volt, D.C. reversing type planer motor and control.
72" x 72" x 15' N-B-P Heavy 4 heads, double deck table. 230V, DC Reversing motor drive.

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100" GOULD AND EBERHARDT Horizontal for spur, helical and worm gears. Max. capacity 101" diameter. 48" face. Forced feed lubrication.

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6" & 10" PRATT & WHITNEY Vertical Shaper with rotary table, power feeds, tilting ram. AC or DC motor drive.
14" STEPTOE Crank Shaper.
15" NEWTON Crank Slotter, 30" circular table, AC or DC.
16" SPRINGFIELD Crank Shaper.
18" DILL Crank Slotters.
22" N-B-P Crank Slotter.

MISCELLANEOUS

30' No. 3 HILLES & JONES Plate Edge Planer.
30' x ⅞" NBP Bending Rolls, pyramid type.
No. 2 PRATT & WHITNEY Jig Borer with 22" x 44" table.

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No. 96A Toledo Double Crank Bed 44 x 48"

No. 308A Bliss Straight Sided, bed 30 x 38", Tie Rod Frame

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Boring Mills, 36"-42"-52"-72"-96.
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Press, Forging 1000 Ton United St.-Hyd.
Planer, 36"x36"x12' Powell 4 Hds.
Planer, O. S. 60"x60"x14' D. & H., M.D.
Planer, 12'x12'x34', 4 Heads, M.D.
Profiler, #13 P. & W., B.D.
Shapers, 10"-20"-24"-36".
Shaper, 36" Morton Draw Cut

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AUTOMATICS, Gridley, ¾, 1¼, 1¾, 2¼" & 2⅝ Model F, M.D.
AUTOMATICS, Gridley, 2¼, 3¼, & 5¼" M.D.
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AUTOMATICS, Cleveland ⅞, 1¼, & 2" Mod. B
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GRINDERS, Brown & Sharpe #2 & 3 Universal
GRINDER, Brown & Sharpe #11 Plain, M.D.
GRINDER, Heald #72 Hydraulic, 2 M.D.
GRINDERS, Diamond Surface #2, M.D.
GRINDER, Norton 10"x36" Hydraulic, M.D.
GRINDERS, Landis Hydraulic, 6"x18". M.D.
GRINDERS, Pratt & Whitney 12" Vert. Surface
LATHES, Hendey, E.B.M. type, 14"x7' & 8' M.D.
LATHES, Hendey, 16"x6' & 8' & 18"x10' M.D.
LATHES, Reed-Prentice, 24"x12' G.H. M.D.
LATHES, Rockford, 18"x8' Geared Head, M.D.
LATHES, Turret, Warner & Swasey #4 G.H. M.D.
LATHES, Morey #3 G.H. Turret, M.D.
LATHES, Lo-Swing 4"x36" Seneca Falls
MILLING MACHINES, #2B Milw. & Vert. Hd.
MILLING MACHINES, Becker Vertical #5 & 6
MILLING MACHINES, Milwaukee #1B Plain & Universal 1A #2 & 3B Plain, M.D.
PLANER, Gray 30"x30"x8' two rail Hds.
PLANER, Ohio 42"x42"x10' One Head, M.D.
ROLL FORMING MACH. Yoder 6 spdle, M.D.
TAPPERS, Garvin #2 & 2X, M.D.
Thread Roller, Watson-Flagg, Late type—3/16" to 2¼" cap.

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1—#16—16" Bryant Internal Grinder Hydraulic type, motors 220-440/3/60.

1—#16RS 16" Bryant Internal Grinder Serial #P4970. Motor 220-440/3/60.

Both very little used

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CLOSEOUTS

BORING MILLS
HORIZONTAL

2½", 4" Binsee

VERTICAL

66", 120" Niles
54" Colburn, M.D., 2 hds.

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Foster Nos. 4, 5, 6, 1B, 3B M.D. Univ.
J. & L. 2¼"x24", 3½x30".
Acme 3¼" M.D.
No. 1L Gisholt Univ. M.D.

GRINDERS

P. & W. 14", 18", B.B., Vert. M.D.
Blanchard 30", M.D.; Modern 12x48" M.D.
Norton Hydraulic 12x18", M.D.
Heald Nos. 72A3 Gagematic
Norton 50"x28', M.D.
Landis Type A 6x20" Hydraulic, M.D.
Bryant No. 12, M.D.
Nos. 50, 55, 60 Heald Int. Hydraulic, M.D.
12" Heald Rotary, Arter 12" M.D.
B. & S. No. 2 Surface, M.D.
Norton 10x36" Hydraulic, M.D.
B. & S. No. 10 1' Cyl.
No. 2 Cincinnati Centerless, M.D.
B. & S. No. 1, 3 Universal
#25, #35 G. & L. M.D.

LATHES

McCabe 26-42"x14'
26x12' Boye & Emmes 3 step cone, B.D.G.
20"x14' Rahn-Larmon, raised to 24"
14"x6', 16"x6' Hendey
9" LeBlond Automatic
36x30' Putnam, M.D.
36x22" Putnam, S.C.G., D.C.M.D.
32"x36' Wickes
Putnam 42x16', M.D.
30x26' L. & S. 12 speed M.D.
P. & W. 1x18, 1¼x18 Automatic Lathes

AUTOMATICS

B. & S. No. 2, Hand Screw
B. & S. No. 00, 0
5 Spdle. Davenport 9/16" cap.
Cleveland Model A ⅛", ¾", 1⅛", 2"
Cleveland Model B 1", 2"
P & J 6A, M.D.
⅞" Cone 4 spindle

New In Stock

5, 10, ton OBI Power Presses
7" Ammco Shapers
Halco H.S. Vertical Milling Heads, Drill Presses
Kalamazoo Metal Band Saws

RADIALS

4', 5', 6' American Triple Purpose
4', 5' Cincinnati-Bickford
4' Mueller, M.D.; 4' 5' Western, S.P.D.
4' American Hole Wizard

MILLING MACHINES

Cincinnati, #2 Univ.
No. 3S Cincinnati, S.P.D. rapid trav. M.D.
Nos. 1Y, 0Y, 3, 4, 5 B & S Plain & Univ.
B. & S. Nos. 12, 13, 13B
Hall Planetary Model D Thread Miller
Providence Planer Type 32"x8'
Becker Nos. 3, AB, 5, 6 Vert.
Nos. 3, 4, Cincinnati Vert.
P. & W. No. 12, 30 Profiler, M.D.
K. & T., B. & S., No. 2, 3 like new
B. & S. No. 2, 3, Vert.
Kempsmith No. 1 Univ.

MISCELLANEOUS

Gorton No. 1S, 3U Engraving Machine
6 spindle Avey Drill, 15" overhang
Rochester No. 5½" B Hammer
6" Vertical Shaper, P & W
Oster Pipe Machines, 4", 6", 8", M.D.
N.B.P. 15" Slotter, M.D.
10x10 Peerless Universal Shaping Saw
#7, 72 Fellows Gear Shapers
No. 8 Marvel Band Saw, M.D.

AARON MACHINERY CO.

MDNA

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LIQUIDATION

MACHINE TOOLS—LATEST TYPE

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1—3A Warner & Swasey
1—1A Warner & Swasey
2—#6 Warner & Swasey P.R.T.

DRILLS

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1—3 Spindle Allen 8" High Speed #2 Morse Taper

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#2 Kearney & Trecker Timken Bearing Dial Feed
#2 Brown & Sharpe Vertical
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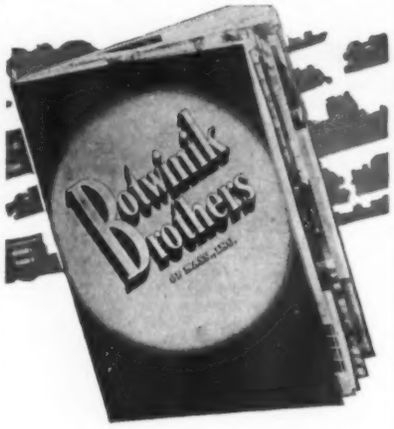

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18" Libby, 3½" Hole in Spindle
No. 4, No. 6 Warner & Swasey
No. 2 American Brass Lathe

MISCELLANEOUS

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Oliver Ace Univ. Tool & Cutter Grinder
No. 27-MB Smalley-General Thread Miller
No. 6 Lees-Bradner Thread Miller
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10 x 36	14 x 36	18 x 96
10 x 50	14 x 50	18 x 120
10 x 72	14 x 72	24 x 96
10 x 96	16 x 50	24 x 240
	16 x 72	

HILL-CLARKE MACHINERY COMPANY
651 Washington Boulevard
Chicago 6, Illinois

SURPLUS HOBART ARC WELDERS

200, 300 AND 400 AMPERE RATINGS

Three million dollars worth of surplus Hobart Arc Welders *must* be sold between May 15th and June 15th. Most of this equipment is of the MG type but some quantity is available in gasoline driven units. Arrangements may be made to inspect the offered items. Largest inventories are located at Boston, Detroit, Cleveland, Chicago, Atlanta, Kansas City, Richmond and Philadelphia—but information on availability, condition and location may be obtained at any of the War Assets Administration Regional Offices listed below. The equipment will be sold on a "where is, as is" basis . . . used or unused . . . and priced accordingly. For full information contact the nearest office listed below or check and mail this coupon.

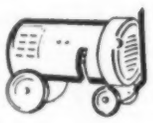
ALSO MANY OTHER TYPES OF WELDING AND FLAME CUTTING EQUIPMENT

LINCOLN

Hundreds of Lincoln Arc Welders in the popular 300-400 Ampere size are also available; some gasoline engine driven.

WESTINGHOUSE

Flexarc equipment for production or construction operations is available in smaller quantity. Also other standard makes and ratings.



RESISTANCE WELDERS

Spot Welders located in Philadelphia, Detroit, Chicago, Los Angeles, Cleveland and Kansas City; *Seam Welders* in Cleveland, Chicago, Detroit, Birmingham, Boston and Philadelphia. Also *Flash Welders.*

WELD POSITIONERS

In standard sizes and types, are located in Detroit, Boston, Chicago and New York.

FLAME CUTTERS

Save production time and money with portable or stationary, single or multiple torch flame cutting machines. All types of gas cutting equipment available for quick sale.

VETERANS OF WORLD WAR II—To help you in purchasing surplus materials, a veterans' unit has been established in each War Assets Administration Regional Office.

FREE SALE FACTS

To War Assets Administration:
Please send me information prior to your sale on the availability, condition and location of Hobart Arc Welders of the following

types:..... and ratings:.....

....

....

I am also interested in:—

- ☐ LINCOLN ARC WELDERS
- ☐ WESTINGHOUSE ARC WELDERS
- ☐ .....ARC WELDERS (other)
- ☐ SPOT, SEAM, FLASH WELDERS
- ☐ WELD POSITIONERS
- ☐ FLAME CUTTERS

Name.....

Firm.....

Address.....

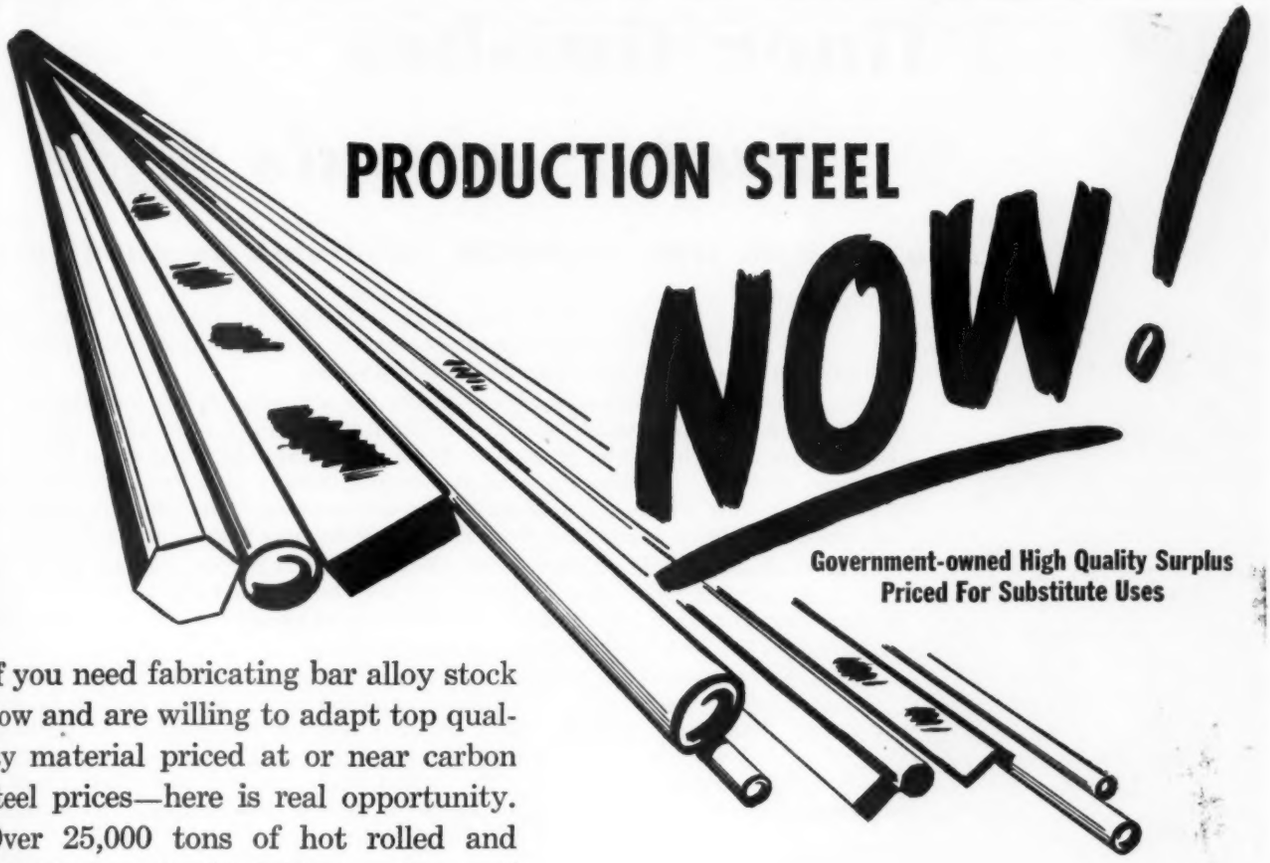
City..... State..... 176-2

All items subject to prior sale

WAR ASSETS ADMINISTRATION

OFFICES LISTED BELOW ARE TEMPORARILY IN RECONSTRUCTION FINANCE CORPORATION AGENCIES

Offices located at: Atlanta · Birmingham · Boston · Charlotte · Chicago · Cleveland · Dallas · Denver Detroit · Helena · Houston · Jacksonville · Kansas City, Mo. · Little Rock · Los Angeles · Louisville Minneapolis · Nashville · New Orleans · New York · Oklahoma City · Omaha · Philadelphia Portland, Ore. · Richmond · St. Louis · Salt Lake City · San Antonio · San Francisco · Seattle · Spokane Cincinnati · Fort Worth (Telephone 3-5381)



PRODUCTION STEEL NOW!

Government-owned High Quality Surplus Priced For Substitute Uses

If you need fabricating bar alloy stock now and are willing to adapt top quality material priced at or near carbon steel prices—here is real opportunity. Over 25,000 tons of hot rolled and 25,000 tons of cold finished carbon and alloy steel bars are ready for immediate shipment to you. The stock is available in standard sizes, shapes, but is of above average grades. Accordingly it has been priced at levels such as to insure its quick employment to meet America's postwar needs. For details on F.O.B. locations, sizes, quantities and shipping arrangements contact your nearest W. A. A. Regional Office below . . . or clip and mail this coupon.

VETERANS OF WORLD WAR II: To help you in purchasing surplus property from W. A. A. a veterans' unit has been established in each of our Regional Offices.

FREE INFORMATION

To War Assets Administration:

Please send me information on the availability and pricing of the following:

Carbon and Alloy Billets, Blooms, Slabs, Rods, etc. ☐
H. R. & C. F. Alloy Sheets, Strips and Plates ☐
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finer finishes

faster speeds

You get <u>both</u> with MADISON Adjustable Reaming Tools

. . . because they produce a mirror-like finish at "roughing" speeds. In most cases, the need for additional finishing operations on the hole is eliminated. Madison's simplicity of design and operation makes this possible.

For example, Madison's two cutting blades are always perfectly centered in the bar. This effects maximum efficiency from both cutting edges. Generous space for chip clearance and circulation of the coolant prevents danger of clogging, and reduces heat and friction. Madison's cooler, free-cutting action produces the smoothest finish, holds close tolerances, reduces rejects and prolongs tool life. As Madisons have only two blades, regrinding is faster and maintenance time is reduced.

The Madison Reaming Cutter is floated in the bar at the exact point where the cutting action takes place. No special floating tool holders and chucks are necessary. Madison cutters are interchangeable. A sharpened and presized cutter can be inserted in a Madison bar without disturbing the original setup.

Through Madison's specialization in boring problems, a complete line of tools has been created. Each tool is specifically designed to perform a certain type of operation. Therefore, Madison offers a better method for production problems involving rough boring and finishing straight holes or complicated multi-diameter holes. You'll find Madisons offer you a better way to lower hole costs. Write today for the free Madison catalog containing full information on our complete line.

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...from tiny acorns grow

DESIGN

A complete engineering service, backed by an experienced staff, is at your service to make recommendations and design special cutters.

RANGE

Hundreds of sizes, dozens of models to meet every requirement, regardless of machines used or materials to be cut.

SERVICE

Even special tools use standard parts which are stocked by us. There are 20 Lovejoy service centers throughout the U.S.A. — there is one near you.

30 YEARS' SATISFACTION

Nearly 30 years' continuous experience making milling cutters and other "Positive-Locking" tools. Our first customers are still buying our tools.

Lovejoy's business is based on a sound idea. Small in size? Yes. Big in importance? Yes. This sound idea is the "Positive-Locking" device used to secure the cutting blades in Lovejoy Milling Cutters. It consists of just two parts — the serrated shoe and the locking wedge. Tools needed for blade adjustment consist of a pin and hammer.

It is simplicity itself, yet blades are held immovably, even under the strains imposed by negative rake carbide cutting practice — even when these cuts are intermittent.

Lovejoy makes superior milling cutters—has experienced engineers to help on any standard and special applications—has a range of models and sizes for every job—has nationwide service for your convenience.

LOVEJOY TOOL COMPANY, INC.
SPRINGFIELD, VERMONT, U. S. A.

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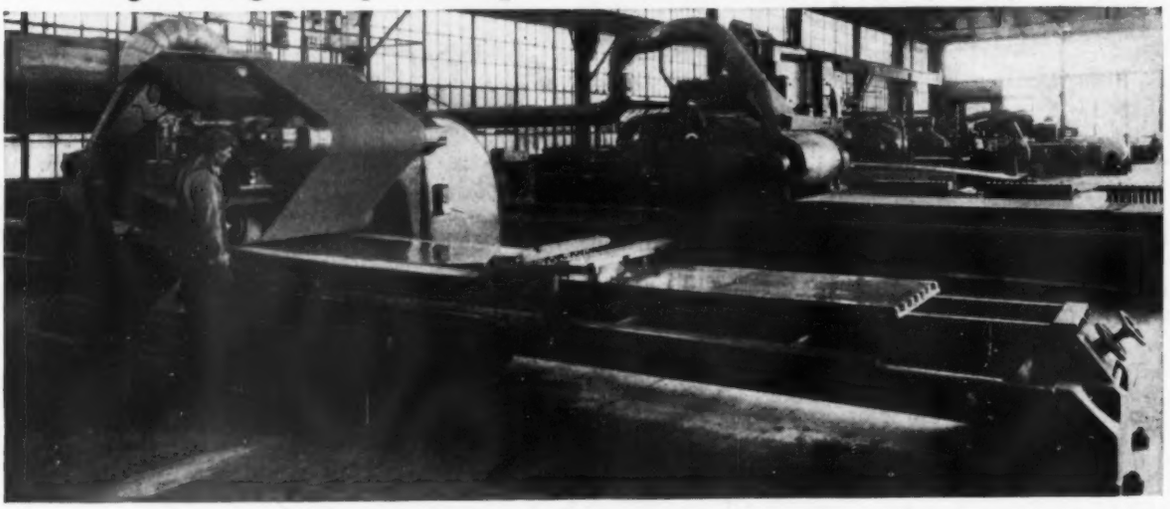
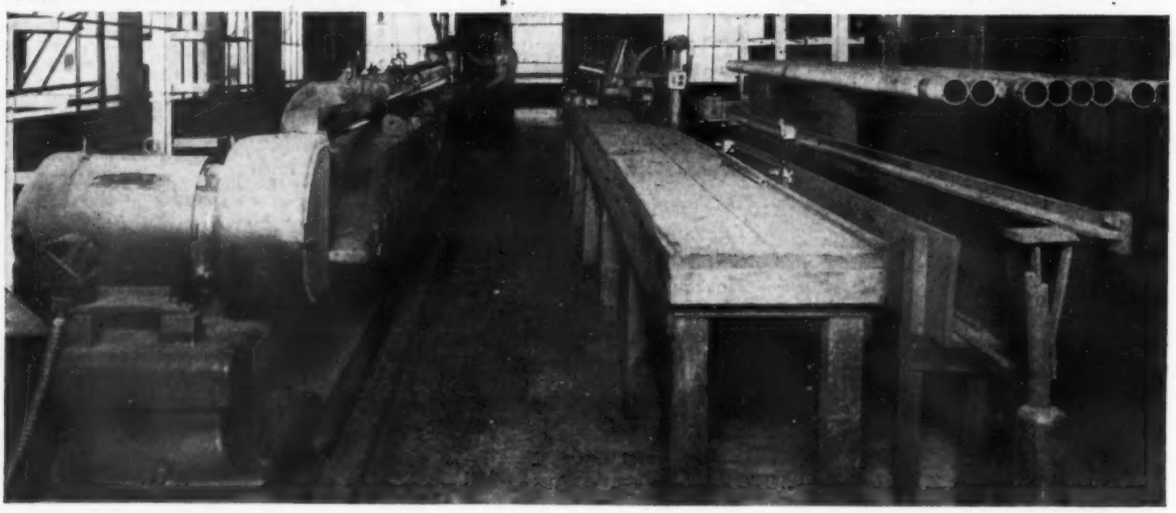
MATTISON WIDE BELT GRINDING AND POLISHING MACHINE...
Designed for proper application of Factory-Coated Abrasive Belts to the grinding and polishing of Stainless Steel and Alloy Sheets.



MATTISON INTERNAL TUBE GRINDING AND POLISHING MACHINE...
for finishing the inside of metal tubes through the use of Factory-Coated Abrasive Belts.

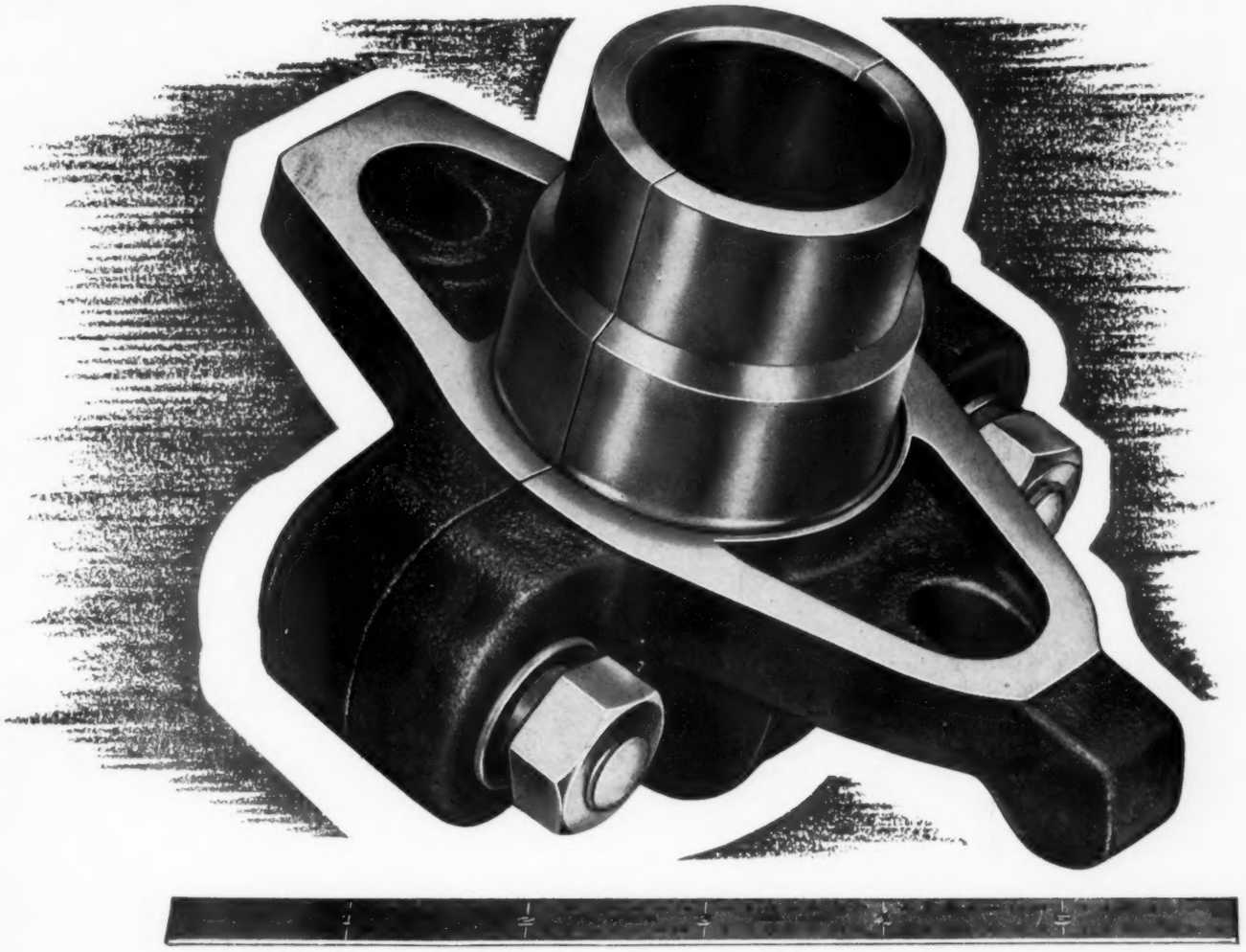


From the time factory coated abrasive belts were introduced for metal polishing and grinding, Mattison's have developed and built machines properly applying belts to the job to be done. If your polishing work includes wide sheets or the inside of tubes you will be interested in the capabilities of the two machines shown above.

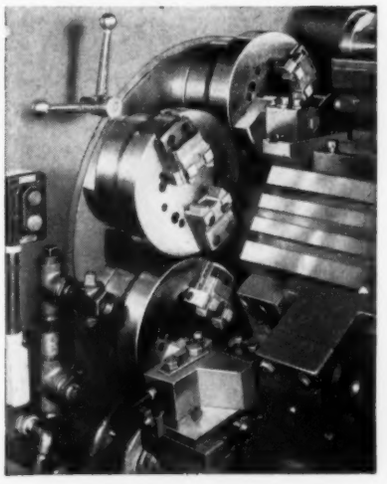
Separate Circulars are available giving complete information on the machines shown. Write for free copies today.

MATTISON MACHINE WORKS
ROCKFORD · ILLINOIS

LEADERSHIP BASED ON ACCOMPLISHED FACTS...



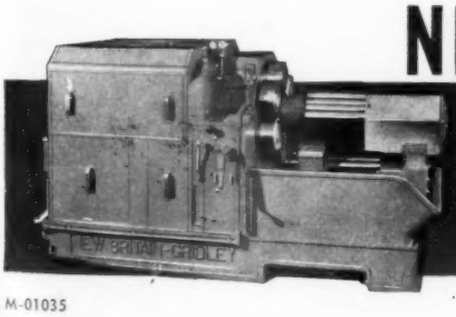
A case of machining a complete sub-assembly



Illustrated above is a malleable iron hub used in textile machinery. The two halves bolted together as shown are loaded exactly like a single piece, and our Model 16 Six Spindle Automatic Chucking Machine performs the facing, turning, chamfering and undercutting operations with a substantial saving of time and cost.

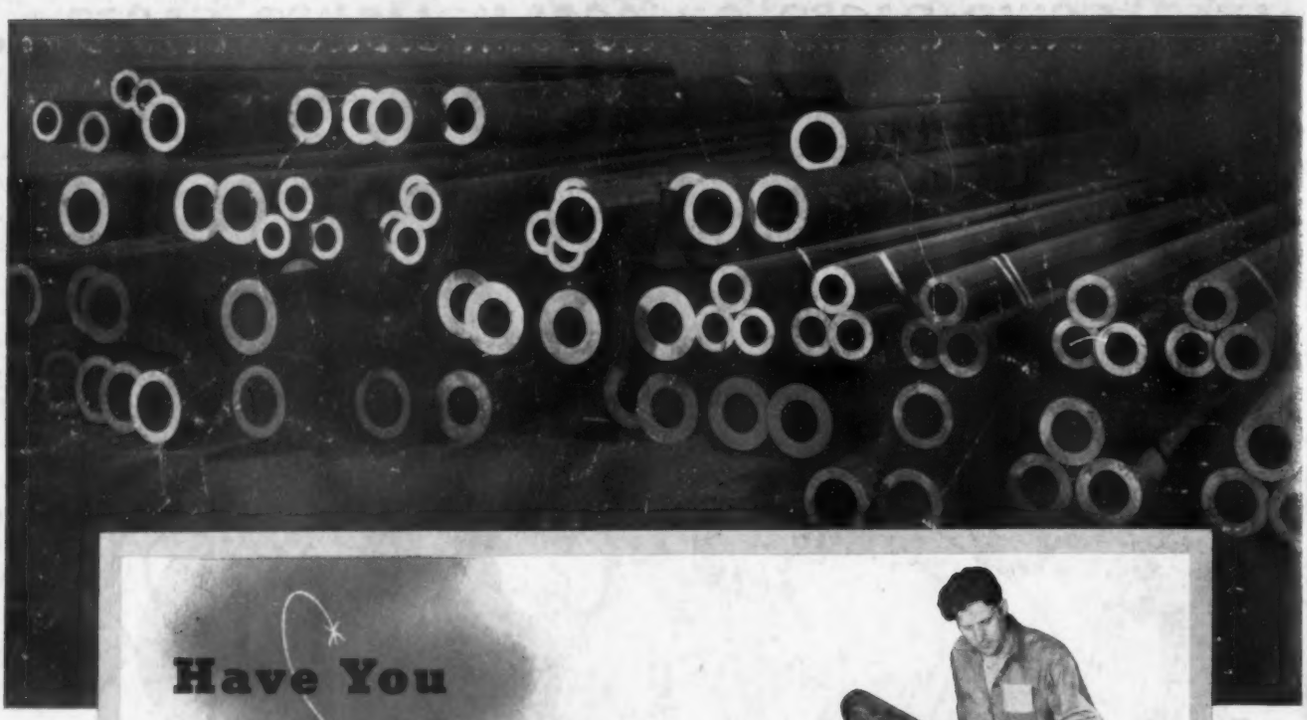
This interesting job may well suggest important possibilities in connection with your products . . . Our engineers will gladly put their time and experience at your disposal to help you discover profit-making advancement in any machining application. Consult the New Britain sales engineer in your locality or write The New Britain Machine Company.

NEW BRITAIN AUTOMATICS



THE NEW BRITAIN MACHINE COMPANY
NEW BRITAIN, CONNECTICUT
NEW BRITAIN-GRIDLEY MACHINE DIVISION

M-01035



Have You Investigated THICK-WALLED TUBES?

Whole new fields of design, and new possibilities for more efficient production have been opened by Timken heavy wall Seamless Tubes. Thanks to another achievement of the Technical Staff of The Timken Roller Bearing Company, tubing can now be pierced with walls 2 inches thick.

During the war, when heavy gun barrels had to be turned out fast, our research engineers pioneered this new method on a mass production basis. No other producer has so much experience in making heavy walled tubing.

Bring your requirements to heavy wall tubing headquarters! You'll find here a complete range of alloy steel grades in standard or special qualities and finishes. And you'll find here a range of tube diameters and wall thicknesses that can be produced only from the largest stock of roll sets for mechanical tubing in the country. *The Timken Roller Bearing Company has that equipment.*

No obligation — ask for an "on-your-job" analysis by our skilled Technical Staff, and for free 8 page folder, "Timken Seamless Steel Tubes, Finishes and Sizes." Write today to Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE MARK REG. U. S. PAT. OFF.
Fine Alloy
STEEL AND
SEAMLESS TUBES

★ YEARS AHEAD — THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS in hot rolled and cold finished Alloy Steel Bars for forging and machining applications, as well as a complete range of Stainless, Graphitic and Standard Tool Steel analyses. Also Alloy and Stainless Steel Seamless Tubing for mechanical and pressure tube applications.